SCIENCE AND TECHNOLO

January, 1957

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THE JOURNAL OF GLASS MANUFACTURING

STACKS

the glass industry

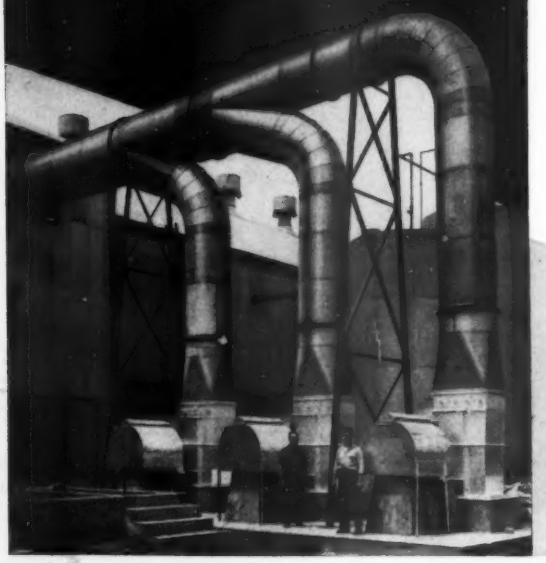
. . . Protective clothing is required in tank repair work in Pittsburgh Plate Glass Company plants. *See page 34.*

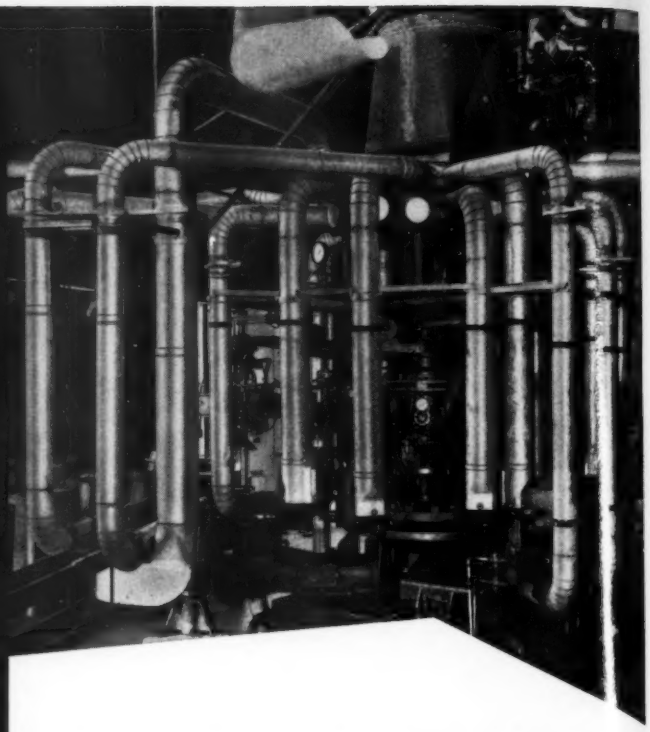
$25,000 PROBLEM:

pressure IN
-pressure OUT

= Lost Power Dollars

SIMPLE ARITHMETIC ... BUT VITAL TO YOUR COSTS!





$25,000 per year is the approximate power cost of a typical furnace and machine cooling system in container plants.

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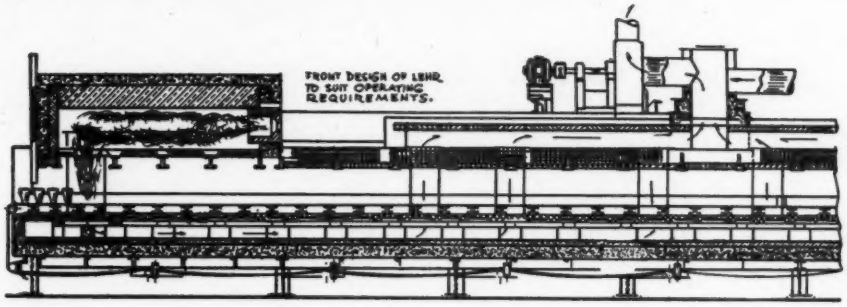

Simplex Lehrs of the full-muffled type have been operating successfully for many years using light and heavy grades of fuel oil, natural gas and raw producer gas. A conversion from one type of fuel to another requires only a change in the burner equipment.

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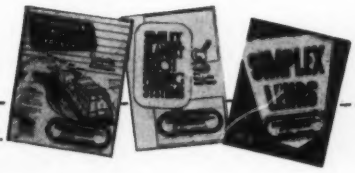

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the glass industry

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the glass industry
VOLUME 38, NUMBER 1, JANUARY, 1957

The Glass Industry—1956

By H. E. SIMPSON
State University of New York, College of Ceramics at Alfred University, Alfred, N. Y.

I. INTRODUCTION

During 1956, there were several important mergers, confined principally to those industries manufacturing containers. The Owens-Illinois Glass Company and National Container Corporation have completed a consolidation of operations in which the business of National Container Corporation will be operated under that name as a wholly-owned subsidiary of Owens-Illinois. The Continental Can Company, Inc., has purchased Hazel-Atlas Glass Company, and the latter will now operate as a division of Continental Can. This agreement unites one of the leaders in the packaging field with a major manufacturer of glass containers. The National Dairy Products Corporation has also announced the acquisition of Metro Glass Company, Inc.; however, Metro's three plants will continue to operate as the Metro Glass Company.

The year has further been distinguished by continued expansion, new manufacturing, and increased facilities for research. Libbey-Owens-Ford Glass Company, with its plate, window, and safety glass plants located in five states, has completed and put into operation new facilities at Toledo, Ohio, and Ottawa, Illinois, which increase its capacity for making polished plate glass by conventional methods 50 per cent. L.O.F. Glass Fibers Company has announced plans for a new "Research Center" at Waterville, Ohio.

Pittsburgh Plate Glass Company has a new window glass plant under construction at Decatur, Illinois, and a 34 million dollar precision-ground plate glass plant at Cumberland, Maryland, in the process of erection. A new research laboratory is also under construction in Harmar Township near Pittsburgh.

The Owens-Illinois Glass Company has new plants in operation or under construction at Havana, Cuba; Atlanta, Georgia; and the West Coast. The Owens-Corning Fiberglas Corporation has purchased ground for a new research laboratory at Granville, in close proximity to its Newark, Ohio, plant. Corning Glass Works has about completed a new research and administration center at Corning, New York, as well as a new plant at Greenville, Ohio. Plans have also been announced for the construction of a "Tower of Glass" which will take the form of a 28-story office building to be located directly across from the company's present building at 718 Fifth Avenue, New York City. The Ford Motor Company is reported to be building the "world's largest glass plant" at Nashville, Tennessee, to provide glass for its various automobile products.

Corning Glass and Sylvania Electric Products Company have also announced plans to build a "multi-million dollar" nuclear fuel development and production installation at Andover, Massachussetts. The jointly-owned Sylvania-Corning Nuclear Corporation expects to get into operation in 1958. The plant will concentrate on development and production of nuclear fuel elements and components. This merger is another example of the broadening interest and versatile application of glass manufacturing.

The year has been one of record production in nearly all glass fields. The marked expansion of the many corporations serving the industry is evidence of faith in the future. There appears to be an almost boundless future for glass and glass products.

II. FLAT GLASS

By dint of hard work and ability to produce, flat glass manufacturers have overcome the supply pinch that dogged the industry the past year. The present change in supply was accomplished in what is regarded as record time in an industry that requires massive plants and machinery.

Normally, it would take two years or more to provide additional capacity for such an industry. The shortage resulted from low inventories of both distributors and manufacturers at the start of the year (1956) and record demands for plate and window glass from the furniture, mirror, automotive, and building industries. This remarkable record is a compliment to both management and labor for making this achievement possible.

There has been a trend in architecture which has boosted the square footage of plate and window glass used per capita in the United States in recent years. Formerly, domestic use of window glass was about 3½ square feet per person and plate glass about one square foot. By 1954, however, the figure had changed. Window glass was being used at the rate of 10 square feet per person and plate at about 3½ square feet. And glass use is still increasing. Furthermore, there seems to be no change foreseen in this trend in the immediate years ahead.

Window areas have expanded and now are glazed with both plate and sheet. Not only has the size of exterior wall openings increased tremendously, but the modern homeowner is insisting upon the use of double-glazed insulating units for both windows and window walls. This construction results in twice as much glass, plus special installation. There are also jalousie doors and windows. For full wall treatment there are sliding glass doors of many different styles.

Much work has also been done the past year on the development of new mass production methods for the making of glass seals that are adaptable to the manufacture of insulated glass units. It is expected that this product will be used increasingly in moderately-priced homes, factories and other structures where heat control and comfort are essential factors. Many large buildings are now glazed throughout with insulated glass, and one major structure used 3,000 units while other glass products employed included all-glass doors and 250 large mirrors. Such buildings as hospitals, geriatric homes, schools, laboratories, and office structures where human comfort is given prime consideration are large potential users of insulated glass.

Architects, engineers, and structural designers are all considering the use of glass in curtain wall construction, especially in offices, schools, and public buildings. The use of glass spandrels has been enhanced by improvements in glazing techniques and extensive research into the problem of heat and light transmission through the glass. A new spandrel glass called "Huetex" has been announced. This glass will be made in 12 standard colors, of 5/16-inch glass, to a maximum size 60 by 88 inches. It is a rolled, patterned glass with a textured surface on the weathering side. A ceramic enamel is fused to the back side to give it the desired color. A coating of atomized aluminum is also fused to the back to protect the colored enamel and reflect heat. The unit must be ordered to proper measurements; and, owing to its tempered condition, mechanical strengths of three to five times that of ordinary glass are obtained.

In recent years, the automotive replacement trade has expanded not only in unit volume, but also more significantly in the total footage of glass. For example, since 1945 the average automobile windshield and backlight have increased over 70 per cent in size, as well as being produced in entirely new shapes. Where the jobber or dealer formerly sold two pieces of flat safety glass for about $7.00 in 1946, today he can sell one beautifully curving, wrap-around windshield for as much as $50.

There seems to be a growing trend toward the use of shaded windshields—a graduated band at the upper side of the windshield achieved through tinting of the plastic interlayer—which reduces the effect of sky glare and makes driving more comfortable. A neutral blue tint for this glass has been developed which blends with the natural sky color and tends to heighten values of red colors seen through the glass, thus emphasizing orange shades and not diminishing greens.

Advances in automobile styling point to still larger windshields with more complex curves such as the Twin-wrap, which will appear on some 1957 models. This trend again points up the role of the depot system to help protect the jobber from additional investment in space and from hazards of obsolescence. It also points up the fact that forward planning on inventories is essential in the replacement field.

Market conditions are not too favorable in the window glass field because of the large influx of foreign shipments. Lowering of tariff rates has led to big increases in imports of glass made in foreign plants under low wage conditions. Some of these competitive sources for glass pay wages one-tenth to one-third the federal minimum wage levels set in this country. This influx has resulted in the curtailment of some window glass production in this country.

Production for the year was at a record level. No industry figures are available on production but it is estimated that sales volume has amounted to approximately $577 million.

III. GLASS CONTAINERS

Although glass containers represent one of the oldest forms of packaging, their use is rapidly increasing, in spite of the competition of new materials. The long term growth of glass container usage is shown graphically in Chart 1, illustrating the fact that container usage is growing much faster than either population or consumer disposable income.

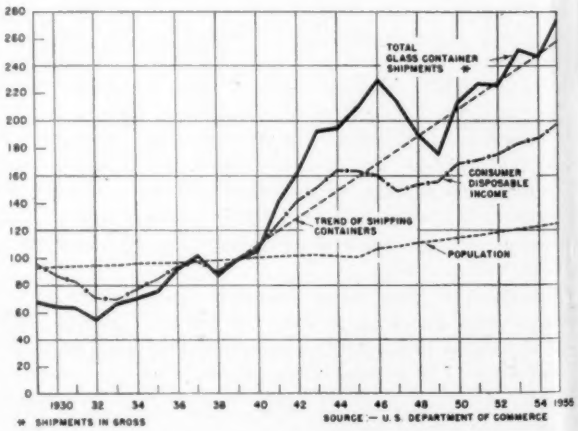

Chart 1. Glass containers are growing faster than population or consumer income. Index: 1939 = 100.

On this chart, the trend line for sales of corrugated and solid fiber shipping containers is shown, for it has been found that this trend is closely representative of the over-all packaging industry. It will be noted that following its post-war low in 1949, glass container usage has advanced faster than this over-all packaging trend.

One major producer in the container field the past year has developed a forming machine that distributes the greatest weight of glass to the areas of the jar where the most strength is needed. The result has been a container that is 20 per cent lighter, yet just as strong. Furthermore, the machine is capable of producing the product twice as fast with important savings in labor and raw materials. This development has been accomplished only after more than 12 years of intensive research in engineering and development at a cost of many millions of dollars.

Perhaps the most interesting development of the past year was centered in the carbonated beverage industry. The novelty appeal of the metal can container had hardly subsided, when attention was dramatically drawn to the glass container by the "Battle of the Big Bottles," launched by the leaders in the industry.

Prior to 1956, certain areas, such as the Southeastern States and Texas, had known virtually nothing but the one-drink sizes (six or seven fluid ounces) while other sections, such as New England and California (particularly Southern California), were known as good "quart" markets. Then certain leaders in the industry began to open up markets all over the country to "family," "king size," or "jumbo" bottles. Ten-, twelve-, and sixteen-ounce bottles, as well as "quarts," were soon being promoted in territories which had never known them before. In the ensuing competitive push, the consumption of soft drinks soared 15 per cent over the previous year, and it will be many months before bottle makers can catch up with the demand for the new sizes.

At the same time shipments of no-deposit, one-way bottles rose to 1,177,000 gross, 22 per cent over the previous year—a significant development in this industry which has traditionally used a returnable bottle. Further, there are strong indications that use of this convenient packaging will continue to grow.

Unlike the soft drink industry, most other users of glass containers are unable to take advantage of the economies of the returnable bottle, for the approximately 5,500 bottlers engaged in this business tend to do business only within reach of their own daily delivery trucks. Despite complaints from some retailers over handling empties, the returnable bottle has proven its ability in this industry to deliver a wholesome, inviting product to the ultimate consumer at low cost yet return the retailer over 300 per cent net annual profit on his investment.

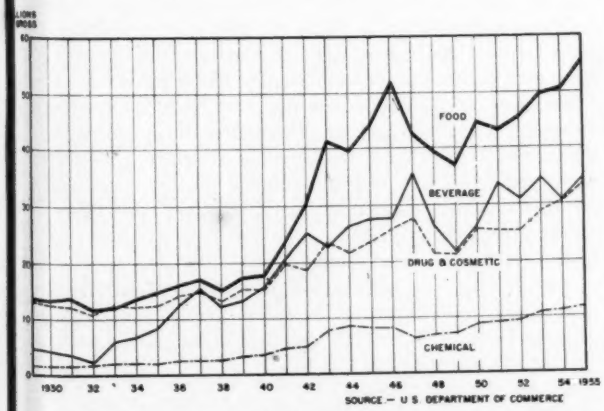

Chart 2. Glass container shipments by end use: food, beverage, drug and cosmetics, chemical.

Chart 2 illustrates the use of glass containers according to certain broad categories. Most important of these users is the food industry which accounted for 41 per cent of new glass containers shipped last year, a gain of 10.5 per cent over the previous year.

In the food field, as always, new or increased uses for glass containers are inaugurated almost daily. The trend to glass for baby foods continues, and today over 70 per cent of processed baby fruits and vegetables are in glass. Growth in the use of glass for these products has been particularly marked in the West, for baby foods marketed east of the Mississippi are practically 100 per cent glass packaged. New and improved processing methods have resulted in rapidly increasing packs of baby meats in glass during the past year.

Of particular interest in California is the very strong latent preference for ripe olives in glass—latent only because such a small part of the pack is available in glass. The Sammis Surveys show that 55 per cent of all housewives not only would prefer to buy ripe olives in glass, but also ask why they are not generally available that way.

There are increased sales opportunities for packers who will market tomato juice and other products in glass containers. In 1955, 60 per cent of all housewives surveyed favored glass containers for tomato juice compared with 52 per cent for the previous year.

Relatively new products in glass or new styles of packs which had very encouraging market tests last year include fresh citrus fruit sections which are not processed, but handled under refrigeration. Florida growers are opening up large markets for this product in the Northeast. In California frozen orange juice concentrate has been successfully market-tested in tumblers decorated with ceramic figures. The use of the decorated tumbler for orange juice concentrate indicates that there is a growing tendency to use these attractive packages as a form of built-in premium.

As long as a new series of decorations is introduced periodically, there seems to be an almost unlimited demand for these tumblers which double as tableware; cheese spreads, jams, jellies, peanut butter and many other products are using growing quantities of them. An interesting new variation of this theme is a package in the form of a decorated old-fashioned glass.

Other examples of glass containers which exploit the re-use factor are wide mouth peanut butter containers which serve as pantry jars; mayonnaise jars which take regular home canning fitments; containers in the form of freezer jars, footed dessert dishes; and many others.

In the retail store, glass occupies a more important position than ever before. Personal selling is rapidly giving way to self-service not only in the food and beverage fields but also in cosmetics and drugs as well. The glass package becomes its own show window which attracts and sells.

A supermarket study entitled *They Buy By Eye*, made by Marathon Corporation, reveals that 78 per cent of the shoppers look first for the picture (or the product itself, if in glass) rather than the lettered name of the product.

Shipments of glass containers for 1956 were approximately 140 million gross or 20.2 billion units. This figure represents a record year and an increase of about 2.5 per cent over 1955 in which 138 million gross or 19.7 billion units were shipped. A comparison of glass container shipments for the first eight months of 1956 and 1955 is given in Table I. The trend as of last August showed an increase in shipments for most narrow neck containers but a decrease in nonreturnable beverage bottles. There was also a noticeable decrease in certain wide mouth containers such as toiletries, dairy products, and packers' tumblers.

In 1955, 43 companies in the United States making glass containers had annual sales of $708 million. This sales record was the result of a record shipment of 138 million gross. It is predicted that with an estimated population of 178 million and a real disposable income of $270 billion in 1960 the shipment of new glass containers will exceed 163 million gross.

TABLE I

Glass Container Shipments, First 8 Months 1956*
(000 Omitted)

	1956	1955	% Change
All Types, Total	94,762	92,136	+ 2.9
Direct exports	1,919	1,797	+ 6.8
Domestic	92,843	90,339	+ 2.8
DOMESTIC, BY TYPE			
Narrow Neck, total	58,483	56,305	+ 3.9
Food	9,781	9,229	+ 6.0
Medicinal	10,603	10,248	+ 3.5
Household and industrial	6,640	6,460	+ 2.8
Toiletries and cosmetics	6,404	6,252	+ 2.4
Beverage, returnable	6,944	6,768	+ 2.6
Beverage, nonreturnable	864	904	— 4.4
Beer, returnable	2,071	1,993	+ 3.9
Beer, nonreturnable	5,991	5,807	+ 3.2
Liquor	6,156	5,746	+ 7.1
Wine	32,029	2,898	+ 4.5
Wide Mouth, total	34,360	34,034	+ 1.0
Food[1]	25,292	24,611	+ 2.8
Medicinal and health	3,332	3,020	+10
Household and industrial	1,407	1,436	— 2.0
Toiletries and cosmetics	1,729	1,830	— 5.8
Dairy products	1,661	1,745	— 4.8
Packers' tumblers	939	1,392	—32.5

[1] Including fruit jars and jelly glasses.
* Glass Container Manufacturers Institute, Inc.

IV. GLASS BLOCKS

Glass block production in 1956 was approximately the same as it was in 1955—a record year. One of the most interesting possibilities is the use of blocks as a curtain wall material rather than merely a means of fenestration. The introduction of block with the tinted blue-green screen has given considerable impetus to this trend.

V. GLASS FIBERS

Perhaps the most impressive growth record in the field of glass during recent years has been that of glass fibers. The sales volume for the entire industry is in excess of 200 million dollars, and the sales goal for 1960 is conservatively estimated to be 250 million dollars.

Major sales gains have been recorded for household appliance insulation, noise control products, roofing products, pipe insulation, and insulation for air conditioning, including replacement air filters. Export sales, although still a relatively small part of the total sales, have shown an increase of about 64 per cent.

Some of the more interesting developments in the field the past year are listed as follows:

Glass-Reinforced Plastics

There are many types of reinforced plastics using glass, cotton, rayon, nylon, asbestoes, and paper as reinforcing materials. *Reinforcements may be cloth or merely random fibers.* Thermosetting phenolic, melamine, silicone, epoxy, and polyester resins are used. Most widely used are phenolics and melamines, press molded at relatively high pressures into the so-called high pressure laminates. Another type is molded under low pressures (about 300 psi or less) or no pressure at all. Low pressure laminates are mainly polyesters, although silicone, phenolic, and epoxy plastics have been used. Although paper, cotton, and other materials have been tried, glass fiber and fabric are the usual reinforcements in low-pressure laminates.

Tanks, pipes, hoods, and ducts are made of these reinforced materials. The combination of corrosion resistance and strength is the prime advantage. Pressures contained cannot be very high, unless some seepage through the pores can be tolerated. Applications have been made in processing and electroplating in chemical, paper, textile, metal finishing, and allied industries. Large duct systems carry away fumes from automatic pickling and phosphating machines. A recent job included 500 gallon tanks and necessary pipe and fittings for a laboratory waste system. Truck water tanks have been successful, with light weight and rust resistance the big advantages. Crude oil tanks, bolted together in sections, resist hydrogen sulfide, salt water, and electrolytic action. If, however, the equipment must be cleaned thoroughly and requires an enamel smooth surface, glass-plastic cannot be used, for its surface retains dirt.

Trays and tote boxes made of reinforced plastics are light, strong, and chemically resistant. They are easy to make, but cost more than similar metal products. In some cases, glass-plastic has not been durable enough. Deep trays, for example, were made too thick and lacked resiliency so that they broke in hard usage. Thinner walls and metal wire reinforcement at the top edges may be the remedy. Materials handling trays for bakery trucks are made in quantity as well as pans and trays for water evaporation and chemical handling.

During 1956, the sales for reinforcements for moulding compounds approximately doubled, with applications ranging from radio and TV cabinets to hammer handles.

Military Applications

Over half of the glass-polyester parts now being made are for military application. Radomes were one of the

first applications and are still important. The material is strong enough to withstand the air pressures in aircraft applications. Corrosion by salt water and rain is no problem. Most important of all, glass-polyester is transparent to electromagnetic radiation. Solid and honeycomb structures have been used. Probably no other material could do the job. Some of the largest glass-polyester pieces made are radomes.

Ducts for the B-47 jet bomber have been molded from preforms. Weight saving is one major advantage over aluminum. In addition, molding of the complex duct shapes was easier. For example, special tools and fixtures would have been needed to make aluminum ducts. Junction boxes and most of the safety equipment are other B-47 applications. Other military applications are crash helmets and bullet-proof vests. Strength and light weight are the desirable properties in these products.

Architectural Materials

Two of the largest fields of application are in furniture and architectural materials. In utilitarian industrial and military shelters like plane housings and refrigerator buildings, light weight, corrosion resistance, strength, and, to some extent, heat insulating value are required. In some places unpigmented translucent material is used in windows. A soft diffuse light is admitted, and breakage is eliminated. The same properties are valuable in lamp shades. The ability of the material to be molded easily into complex, interesting shapes has encouraged its use in chairs and corrugated and patterned wall panels and screens.

Automobile Safety

New concepts in automobile safety and comfort stimulated trial usage of glass fiber products for instrument panel pads, sun visors, sound absorbing, and temperature control insulation. Glass fiber-reinforced plastics are being used increasingly for automobile and truck components, station wagon trim, for building prototype models, and for low cost, efficient tooling.

A recent, well publicized application is car bodies. Only custom-made or special, low-production bodies are being considered. The material is strong enough to make a good body. Its big advantage is that relatively cheap molds are required for a given shape so that custom bodies do not have to bear the cost of expensive dies required with metal. Thus, a new field of comparatively low-priced special bodies is opened up.

Yarns

Sales of yarn for decorative fabrics increased substantially the past year. As a means of presenting new developments and designs in glass fiber fabrics and to make these and a complete line readily available to the public a Fiberglas Fabric Shop has been established at 16 East 56th Street, New York City.

Dentists report that glass yarn, as filling for root canals of teeth, is better and easier to manipulate than gutta-percha. Medical men have found that glass cloth is better than surgical gauze for packing, in pelvic surgery, and for dressing burns and many kinds of wounds. Probably the first reaction to that news is "Glass! In a wound! It would cut and scratch!" But it does not. Glass cloth is less irritating than gauze and does not adhere to the flesh.

Research and Process Development

A number of process improvements have been applied the past year in both textile and general product production. A major development has been the process for making low density insulation products. Further improvements in quality and performance of products and lower costs of manufacture are evident.

Extensive work has been carried out in conjunction with fabricators of glass fiber materials. New and better applications have grown out of such cooperation. Examples of this are the expansion of uses of glass fibers in paper products and gypsum boards, prefabricated ducts for air conditioning and improved techniques for weaving glass fiber fabrics.

Basic research has been directed toward improving the characteristics and lowering the cost of glasses; in seeking more suitable organic and inorganic sizings and resins important in combination with glass fibers; and toward developments in metallurgy, fiber-forming processes, and a wide range of related problems. Many current research and development projects have also been sponsored by the Armed Forces.

Electrical Insulation

An important use of glass-reinforced polyesters is in electrical insulation, primarily as a replacement for phenolics. This replacement is strictly on the basis of lower cost and/or better properties. Compression molded parts and parts stamped from sheet are used. The higher cost in relation to canvas and paper-phenolics is offset by greater strength, impact resistance rigidity, and by the ability to take higher operating temperatures and temporary overload temperatures without blistering, embrittlement, or shrinkage. More vibration can also be endured. Glass-polyester is also easier to punch into intricate shapes than asbestos-phenolic.

In electric motors and generators, slot sticks, slot cell bottom spacers and intercoil separators, armature and laminations, coil end washers and coil head insulation are being converted to this material. Electrical shim stock, electromagnet intercoil spacers, control finger panels, transformer spacers, and terminal locks are also good applications. Moisture and tracking resistance are important in these applications.

Consumable Glass Fiber Ingot Mold Liner

A new and improved method has been developed for facilitating the casting of steel ingots free from surface imperfections and defects. Placing a glass fiber barrier or liner between the ingot wall and the metal stream entering the mold prevents splashing. Fiber glass has proven to be an ideal material for such purposes, preventing the splash from contacting the walls of the mold and decreasing or minimizing the surging effects of the metals. Glass fibers do not leave a large amount of residue, and the glass converts to a small quantity of liquid slag that easily floats out in the metal being poured. The glass fiber barrier is furthermore non-reactive, a poor conductor of heat, easy to install, and relatively inexpensive.

Miscellaneous Applications

A number of other applications are in the tooling-up stage or have just gone into production. Light weight bath tubs for house trailers, loud speaker horns, shower stall bases, and liners for ice chests and frozen food containers are examples. Pressure containers for dispensing hot and cold beverages are in the same stage of development. Another proposed application is table top and panel material made by molding the material around Balsa cores.

Hollywood is building most of its big movie sets of glass fiber products. The highly exciting scene in the movie, *Samson and Delilah*, when Samson tore down the huge pillars of the prison house and tons of stone crashed upon Samson and 3,000 Philistines, was effectively carried out by means of fiberglass. On the screen the casualties were enormous, but actually no actors were harmed, mainly because the pillars and blocks were made mostly of glass! Glass fibers, in plaster of Paris, had been sprayed on molds, forming "stone" blocks that were mere shells, but of great strength and light in weight. The material actually was only one eighth of an inch thick.

Glass sets are comparatively economical. By using glass for King Arthur's castle and the fort in *A Connecticut Yankee*, the producers saved $87,000.

VI. ELECTRONICS

TABLE II

Sales of Receiving and Picture Tubes For First Seven Months 1956

	Picture Tubes		*Receiving Tubes*	
	Units	*$ Value*	*Units*	*$ Value*
January 1956	892,385	17,016,391	40,141,000	31,314,000
February	898,063	17,136,695	37,754,000	30,756,000
March	848,055	15,714,365	42,525,000	34,849,000
April	830,902	15,141,461	35,184,000	28,616,000
May	906,732	16,123,625	33,015,000	27,145,000
June	776,601	13,663,408	39,037,000	32,176,000
July	585,380	10,861,634	31,400,000	24,781,000
Total	5,738,123	$105,657,579	259,056,000	$209,637,000

The Electronics Industry, now celebrating its Golden Anniversary, has become the ninth largest in the United States. Since the development of the DeForest triode vacuum tube in 1906, annual factory sales have shown a strong upward trend. In 1955 the value of radios, televisions, phonographs, military and industrial equipment, and components totaled $5.5 billion. When distribution and maintenance costs and broadcasting revenues are added, the Electronics Industry becomes a $9.7 billion giant—nine times its size at the end of World War II but only half its expected size ten years from now.

During the next ten years, the rate of growth in industrial electronics will exceed even that of consumer electronics during the last ten years. At the end of World War II, consumers owned only a few thousand television sets. At the end of 1955, nearly 37 million sets were in use receiving a signal from 459 television stations.

In 1956, manufacturers' sales of receiving tubes amounted to approximately 445 million tubes with a value of about $358 million.

Cumulative sales of receiving tubes in the first eight months of 1956 were reported by Radio-Electronics-Television Manufacturers Association as 259,056,000 valued at $209,637,000 compared with 254,842,000 tubes worth $189,849,000 sold in the comparable 1955 period.

Table II shows both receiving and picture tube sales by months during the first seven months of 1956.

PARTS AND TUBES

The most familiar electronic component is the TV picture tube. Manufacturers' sales of 10.9 million units during 1955 established a new record. In 1956 it is estimated that approximately 10 million units were sold with a total evaluation of over $180 million. While 21 inch picture tubes continue to be the most popular size, growing consumer demand for portable TV sets is reflected in the increased sales of 15-inch and smaller size tubes.

Transistors, the solid-state devices which in some cases perform the functions of tubes, nearly tripled in sales during 1955 compared to 1954—3.6 million versus 1.3 million. Factory sales were valued at $12.2 million during 1955 and $5.1 million during 1954.

The number of distributors of electronic parts has increased during the last eleven years according to the National Credit Office. The number of firms engaged in the manufacture of primary electronic components has also increased. During 1955, these firms accounted for a significant portion of the $2.1 billion component sales. This amount is the second highest yearly volume, exceeded only by the $2.2 billion sales during 1953.

In 1955 there were 110,300 retailers selling radio and/or television receivers. This was an increase of 14,900 from the number handling industry products in mid-1952 when the FCC "freeze" on new TV station construction was lifted.

MILITARY

Application of electronic principles to military equipment extends the ability to see and hear through radar and sonar, guides the path of missiles, and regulates the timing of shell explosions. Vast quantities of radio equipment, from million watt transmitters to pocket size receivers, form the life line of military communications. Guided missiles are making piloted aircraft obsolete for many purposes. It is estimated that missiles and rockets will replace piloted aircraft in 50 per cent of strategic missions and 30 per cent of tactical missions. The total missile and rocket expenditure has increased fifty times —from $21 million in 1951 to nearly $1 billion in 1955.

Immediately prior to World War II, annual Government procurement of electronic equipment was $100 million. Wartime production expanded rapidly to an annual rate of $4.5 billion by mid-1945. Total deliveries from 1942 through 1946 were $7.5 billion.

From the end of the war to 1950, military electronic production levels declined because of the national disarmament policy. Following the Korean War outbreak, the Electronics Industry again mobilized rapidly. Total appropriations for the military jumped from $13 billion to $48.2 billion, including an electronic equipment increase from $700 million to $4.2 billion. Actual deliveries increased from $500 million to $1.5 billion in 1951, to $2.5 billion in 1952, and to a record $2.8 billion in 1953. The 1954-55 rate of $2.4 billion is expected to be maintained for several years.

COLOR TELEVISION

The present status of color television and its immediate future are in doubt. This doubt does not mean, however, that color television has failed or that the future prospects are poor. There are numerous technical problems to be solved, and many believe that expansion in the field was somewhat premature and perhaps untimely. Production in the field has been spotty, and certainly the number of sets produced have not been as great as was originally anticipated.

A number of companies are presently engaged in an experimental program in the field of glass screens for electronic applications. In this work, investigations of all types of possible uses for glass screens are being considered. Color television—with its requirements for various kinds of masks, screens, and grids — seems an especially promising field.

There are a number of problems still to be solved in the basic glass process. The only successful products in this program to date are extremely fine-mesh screens for military and radar equipment. A few prototypes of a full-size shadow mask for color tubes of standard three-gun design have been made and submitted for consideration. Small samples of other style screens have been made to illustrate the versatility of glass in this form.

The possibility of a successful glass screen for any type color television picture tube appears to be quite likely in the not-too-distant future.

VII. FUSED QUARTZ

In 1955, there were nearly one-half million mercury lamps made and sold, and production has been constantly increasing. The heart of the lamp is a fused quartz arc-tube. It is the extraordinary characteristics of fused quartz that have made possible many of the designs of present types of mercury lamps.

Fused quartz has unique electrical and chemical properties. Its high resistivity, low dielectric losses (particularly at high temperatures), and its ability to withstand wide and sudden temperature changes make it superior to plastics, glass, and porcelain as an electrical insulator. It is chemically inert to almost all acids, hydrofluoric and phosphoric excepted. Its elasticity rating or its ability to resist change in shape under stress and its ability to snap back to its original shape without distortion is excellent. On this basis quartz has almost perfect elasticity. A quartz fiber will untwist completely after being twisted through a large angle and come to rest reliably at zero reading after each deflection.

The minimum expansion of quartz under extraordinary temperature changes and its high melting point compared with other materials or metals has inspired many uses; for example, as an immersion tip or enclosure for thermocouples for rapid recording of temperatures of molten steel. Researchers now cite significant uses of quartz components in radar applications, now that certain publicity restrictions are removed.

One intriguing use of transparent fused quartz disks is in what is called "delayed electricity." The purpose of this is in the memory schemes used as a part of the various designs of the new "electric brain" computers. Delayed action of electricity is accomplished by converting electricity into supersonic sound waves. These are passed through a clear fused-quartz disk by many internal reflections from accurately ground faces on the periphery of the disk. By internal reflections, a single 15-inch flat disk is equivalent to a quartz rod 18 feet long. The speed of the supersonic vibrations through the quartz path is only 1/200,000th the speed of electricity so that when these emerge at the last stage and are again converted to electrical energy, its electrical effect is delayed beyond the same source of electrical energy which was sent by another circuit to the computer. The time delay is regulated by the distance the supersonic waves traverse the invisible labyrinth of reflection paths through the quartz disk. Precision control demands utmost precision in surface grinding.

Rapid strides have been made in the manufacture of fused quartz, resulting in greatly improved products, and are now being applied to the full range of sizes in clear quartz tubing and rod. Almost 50 per cent of all fused quartz made by General Electric Company is used for light sources such as mercury, ultraviolet, photochemical, and other lamps. The remainder goes largely to electronics, chemical and petroleum industries, as well as laboratories and research centers.

Benefits of the improved manufacturing technique include better control of the outside diameter, concentricity and thickness of the tube wall, reduction of flaws in the form of air lines, virtual elimination of surface waviness, while maintaining the same high purity of the product. Variation in the outside diameter of the tubing has been reduced from ± 8 to 12 per cent to ± 4 to 6 per cent. The reduction in the number and size of air lines makes for stronger walls, improved appearance, and permits a more even distribution of light in photochemical lamps used in photocopying equipment.

Elimination of discernible waviness of the surface that previously appeared in sizes above 45 mm. results in far less distortion and in improved stresspattern. The high purity of the quartz increases the desirability of its use in the manufacture of germanium and silicon.

Also being made by an improved manufacturing process are ingots known as Type 6 clear fused quartz. The quartz is practically bubble-free and has the least strain pattern of all quartz types manufactured. This type is reported to be excellent for optical-type fused quartz for such uses as radomes for planes and guided missiles or for delay lines in radar equipment.

Quartz has been a somewhat stubborn and difficult material to process and fabricate. New methods and processes give promise of easier handling and lower production costs. If some of these economic barriers are lowered, there are many ideas being harbored in the minds of those interested in new lamps and lighting devices to insure the business from becoming static for a while at least. Glass technology in recent years has extended glass applications toward the quartz realm functionally. Quartz technology may soon narrow the gap price-wise. Quartz is really a "thoroughbred glass."

VIII. NEW AEROSOL PROCESSES

In 1947 when the commercial aerosol business was born, fewer than one-half million pressurized packages

were sold. Sales reached 34 million pressurized packages in 1951, 96 million in 1952, 131 million in 1953, and 169 million in 1954. Volume in 1956 probably exceeded 250 million.

A new development, announced by Connecticut Chemical Research Corporation and known as the Polysol process, promises to improve aerosol packaging. Under this system, propellants can be non-refrigerant gases used singly, in combination with each other, or in combination with refrigerant gases. With new types of valves and new processing methods also developed to produce aerosols, the application of pressurized packages is increasing greatly.

Some of the propellants investigated include helium, argon, krypton, carbon dioxide, nitrous oxide, butane, and propane, as well as many others. Not all of these gases were satisfactory, but the researchers found some that would do the job, singly or in combination, and in some instances in combination with refrigerant gases.

Glass has a definite advantage over other materials when chemical products, including drugs and cosmetics are under consideration. Glass is inert to nearly all chemicals and therefore will not need the compatibility tests that other package materials must undergo with newly developed formulations. On this score, at least, the glass container is a strong contender for the privilege of taking to market many of the new aerosols expected to be developed.

The new development is expected to remove limitations to many aerosols and to open the way to new products, particularly in the cosmetic, drug, household, and industrial fields. New products, such as antiperspirants, depilatory hair removing compounds, body rubs, mouth washes, medical inhalants, disinfectants, and other such items can be formulated and packaged through the new process.

IX. LITHIUM MINERALS

It is estimated that in 1956 imports of lepidolite and petalite for glass manufacture totaled approximately 18,000 tons, which means that for the first time in three years imports were approximately in balance with consumption. The tonnage spreads to approximately 2/3 petalite and 1/3 lepidolite.

These figures also reflect only ore destined for glass consumption. There were additional, lesser tonnages brought in for other ceramic use, and for lepidolite, in particular, tremendous tonnages for chemical use. It is also estimated that approximately 70 per cent of the glass consumption of lithium ore is specifically in electronics and television glass, while 20 per cent has been devoted to borosilicate glass and slightly less than 10 per cent for miscellaneous glass uses.

Explorations of lithium ore reserves continue to report mounting tonnages. This reserve has inspired various established and projected research projects of a relatively basic nature. One project has been directed toward a study of the properties relating to glass forming areas in various basic systems. These projects are aimed at providing the industry with sufficient basic knowledge to enable glass technologists more freely and more constructively, as well as more properly, to apply lithium oxide in particular and lithium ores in general in the compounding of approved glasses.

Lithium minerals are now established on a high quality basis involving a high degree of control which requires procedures never before necessary to apply to any of the more common glass batch ingredients. While the growth of lithium mineral use in glass has been the result of mounting requirements of a few particular glasses, the expanding knowledge of reserves in general gives rise to researchers looking forward to a much more broader use. Furthermore, prices over the last two years have decreased, and it is quite likely that they will continue to do so in an orderly fashion in the near future.

Little or no spodumene has been imported for glass manufacture. Tremendous reserves have been developed both in Canada and the United States; however, all the tonnage thus far has been directed into chemical manufacture of one type or another. Known reserves could conceivably supply a considerable demand for glass manufacture; however, very little study of a glass grade spodumene product has been made to date. Such projects are of extreme interest and will no doubt be undertaken in the near future.

X. NEW DEVELOPMENTS

Apparatus Glass

A variety of new products to help make laboratory work easier and more efficient has been developed. Included among the latest additions in laboratory and pharmaceutical lines are centrifuge tubes with screw caps, color-coded pipettes, precision bore tubing, and new size fritted filters. A conical centrifuge tube with screw cap is designed for use when separating material with a volatile constituent. According to the manufacturer, centrifuge balancing is simpler with the new tube which is lighter in weight than stoppered tubes.

Available in both plain or graduated types for regular or heavy duty, the new centrifuge tube has excellent mechanical strength owing to uniform glass distribution in its wall, taper, and bottom. The screw caps, which come complete with glued-in inert liners, are fabricated from a special formula plastic.

Included in the tubular fritted filter line is a new porosity—Very Fine—a pore diameter half-way between the standard Fine and Ultra-Fine porosities.

The very fine porosity filters have a nominal maximum pore size of 2 to 2.5 microns and are intended for use in general bacteria filtrations, especially polio vaccine production. The new porosity is available in all items presently made in Fine and Ultra-Fine sizes.

Also added to the fritted filter line is an extra-large tubular unit, 1¾ inches in diameter and 10 inches in length. The larger filter is available in all porosities from Coarse to Very-Fine and Ultra-Fine.

To aid laboratory technicians in distinguishing between various pipette sizes or between pipettes used for separate operations, color-coded pipettes are now available. Both measuring and serological types can be had with red, yellow, blue, green, black, or white color markings. The color coding, which is applied as a stripe near the mouth-piece end, will withstand chemical durability tests for permanent color markings as in Fed. Spec. DD-V-518-a "Volumetric Apparatus: Glass."

(*Continued on page 46*)

Seventeenth Conference on Glass Problems

• On December 6 and 7, 1956, the Seventeenth Conference on Glass Problems was held at the Ohio State University, Columbus, Ohio. Even the weatherman cooperated to produce a record-breaking temperature of 70° F. for December 6. With over 300 in attendance, registrations ranged from California to Massachusetts. In addition, there were present two visitors from England, Messers Clifford Jones and Charles F. Griffith, Pilkington Bros. Ltd., St. Helens.

The opening and welcoming remarks were given by Gordon B. Carson, Dean of the College of Engineering at the Ohio State University. Dean Carson indicated that the trends in modern technical education are now emphasizing "Accent on Learning," with curricula being changed to include more humanities courses in which communication skills are emphasized.

Ralph K. Day, Libbey-Owens-Ford Glass Company, Toledo, Ohio, served as Chairman of the morning session.

The first paper was "Making Silica Crown Insulation Practical" by John J. Webber, Harbison-Walker Refractories Company, Cleveland, Ohio. Mr. Webber indicated that the proper insulation of glass furnace crowns was quite advantageous, especially from an operating point of view. Silica insulating should be used because crown brick are, as a rule, silica brick. Contamination by Al_2O_3 should be particularly avoided because of the fluxing action or approximate 200° C. drop in melting point owing to the chemical activity of Al_2O_3 and SiO_2. It was also recommended that the use of silica sand be avoided because it was liable to sift through any cracks or openings in the crown. Best results were obtained by applying the insulation after the crown had been heated and thoroughly grouted. Emphasis was also placed on the use of thermocouples to ascertain what degree of insulation was finally allowed.

Encouraging operational data were presented to show that fuel savings were effected ranging from $4.85 to $11.25 per square foot of crown areas, and maintenance costs were reduced. Excellent results were obtained with borosilicate glasses in which the life of the crown was increased from 9 months to 6 years.

It was pointed out that the use of super-duty silica brick and super-duty mortar was highly desirable and a distinct aid in the event that too much insulation was applied. This highly practical paper indicated that the point of diminishing returns is not yet reached with as much as a total of 13½ inches of various insulating materials.

The next paper, "Progress Notes on Port Neck Insulation," was presented by George J. Loeffert, United Can and Glass Company, Hayward, California. The insulation of port necks was successfully accomplished over Zac refractories, which were used in these important areas after both basic refractories and sillimanite had given unsatisfactory performance. This fused cast refractory was used in both port roof and side walls, and ample insulation was believed to provide a sufficiently hot face within the port which prevented the concentration of alkalies on this face; hence, less refractory attack was evident. Furthermore, the insulation so reduced the gradient in the walls that spalling was not a serious factor. Other advantages realized were that fused cast provided a denser and tighter wall so that there was less chance for boring and penetrating holes in the refractory. The port contours were also more rigidly maintained, an important advantage with low pressure firing.

After 40 months of operation the refractories were still in excellent condition, and no hot repairs were necessary. Plans were being made to continue and expand the use of fused cast refractories with insulation for these areas. The study was made on a flint container glass that was melted at a rate 5.2 square foot per ton of glass.

The last paper of the morning session was, "Studies of Fuel Savings," by Thomas P. Coyle, The Maryland Glass Company, Baltimore, Maryland. A study was made of fuel savings brought about in the operation of a flint glass tank for container ware. First, the development of better and superior refractories for various sections of the tank was considered. Various types of settings for checkers were described, and the improved performance of super-duty firebrick in conjunction with basic refractories was noted. Improvements in silica crowns were cited as owing to super-duty silica brick.

A novel method of insulation was described, including the use of aluminum panels alone or aluminum panels backed by Transite. The success of the method was caused primarily by the flexible mode of operation in which insulation could be varied to produce a desirable refractory balance in the tank. Tightness of construction was emphasized. The flexible insulation was said to produce a marked saving in fuel required to maintain the idle load of the tank.

The various applications and techniques used were well illustrated with slides and were adapted primarily to side walls, bridge walls, ports, and tank bottoms. Savings of as much as 15 gallons of oil (Bunker C) per ton of glass produced were cited. The method of insulation was considered to be much superior to conventional methods in use. The paper provided considerable impetus to the discussion of the entire problem of insulation.

The Thursday afternoon session was led by R. W. Hopkins as chairman. The first paper was "Improving the Production and Quality of Glassware by Finish Reforming" by Charles T. Stewart, Stewart-Glapat Corporation, Zanesville, Ohio.

Interest in finish reforming started in the late 1930's, when a fabricator found it necessary to fire-finish a tumbler that was to be used by a jelly packer. This tumbler enjoyed a good sales appeal because of its re-use advantages. Up to that time, most tumblers had been pressed and then fire-polished to remove the sharp edges at the ring match.

The general appearance was then improved by melting

out the surface dullness caused by the mold. The production advantages of the wide mouth press and blow were obvious, but the finish was rough and anything but round. If the forming machine were slowed down, about 75 per cent of production would fall within the very liberal tolerances allowed by specifications. For a plant operating at approximately 90 per cent efficiency, such an operation was intolerable. Fire-finishing gave the tumblers the desired smooth edge that permitted re-use in the home, but too many tumblers failed to come within the tolerances allowed by the specifications.

According to consumer surveys, users of glass containers were more interested in the tolerances imposed on the "finish" of the ware than in any other characteristic. The stopper, cork, or cap must fit securely to provide a satisfactory product. Other defects were often tolerable, but improper "finish" was always serious. Because greater emphasis and improvements were desirable in refinish operations, an improved fire-polishing was developed. The numerous difficulties encountered in the development of such machines were revealed, and methods of overcoming these difficulties were enumerated.

The entire reformer assembly was mounted on a movable base plate so that the tension of the carrier chain could be controlled. The machine as designed consisted of the following basic sub-assemblies: (1) A synchronizing drive unit with throw-out clutch to synchronize the carrier chain with the glass forming machine. (2) A short fire polishing machine. (3) A transfer to move the bottles from the forming machine conveyor to the spindle chain. (4) A reforming machine.

Experience to date has indicated that operating costs of the reformer are very low. Because it is fully automatic, the forming machine operator also tends the reformer. Gas for fire polishing has approximated 300 to 400 cubic feet per hour. Electric power is a 7 horsepower connected load. Equipment consists of 48 centering rings for the fire polisher, plus the reforming dies. Both these items were made from Transite in the user's plant. The only maintenance item to date has been the repair of the fire-polisher chain, which must be kept accurate. This problem was reduced by the development of a new style chain riding on ball bearings, which can be replaced without removing the chain from the machine.

After 15 years of progressive development, the user is thoroughly convinced that one of the best opportunities for a major increase in glass container production is to run the forming machine at maximum speed and then reform the finish to a very close dimension. Such an operation would place glass production methods in a sequence similar to that now used in metal working, giving the same beneficial results of lower production costs, and a better quality product.

The next paper, "Preheating, Bending and Fire-Finishing of Glassware," was presented by Carl P. Mann, The Selas Corporation, Dresher, Pennsylvania.

Generally speaking, glass may be heated by gas in three ways: (1) by radiation, (2) by convection and (3) by direct flame impingement. An additional factor, which has a very important bearing, is the thermal conductance of heat through the glassware itself.

Each of the methods of heat transfer mentioned above has its special application in the heat treatment of glass. When it is desired to heat glass rapidly throughout its entire thickness to a relatively high temperature, radiant heating has special application. High temperature differences between the heating medium and glass are readily attainable, and the fourth power function means that the heating rate can be very rapid. One important glass reheating operation is the drying and baking on of the internal fluorescent coating on tubular fluorescent lamps and screens of cathode ray TV picture bulbs.

It has been found that radiant gas heat has a very favorable application in these instances: first for its penetrating quality as stated earlier, and second because the heat may be directed where desired to obtain uniformity. A very considerable amount of glassware is reheated in the process of decorating by the firing on of ceramic colors. In the container industry, this reheating is accomplished by the use of forced convection, for in this method the air may be directed around the irregularly shaped glassware. Where flat glass is to be decorated, either convection air or radiant heat may be used.

Success in the production of tempered flat glass depends in a very large degree on properly controlled heating. This heating must be very uniform so that when the glass is stressed in the quenching operation, the stress will be uniformly distributed, thus avoiding fracture. The heating rate must be rapid because the temperature of the glass must be near the softening point; and if the heating rate is slow, the glass will sag or deform. The inherent qualities of radiant heat dictate its use for this process; consequently it is universally used in tempering flat glass.

One of several ways in which beverage bottles are fire-polished is by a row of special flame burners which direct the flame downward over the tops of these bottles while they are on the conveyor between the forming machine and the annealing lehr. The diameter of the burner is slightly larger than that of the bottle in order to obtain proper action of the flame over the surface of the bottle top. These burners must be designed carefully to avoid the generation of radiant heat, as the interior of the glass would become too hot and deform.

The paper pointed out that within most heat applications for reforming glass it was important that the fuel supply for the burners be under precise control. The most practical means of attaining this objective was to employ machine pre-mixing of the air and gas, for by this means the control was centralized and placed under responsible supervision.

The next paper, "Improvements in Glass Tempering," was presented by Harold A. McMaster, Permaglass Corporation, Toledo, Ohio.

Tempered glass is rapidly becoming a familiar article of commerce, but there are still many engineers, architects, glass fabricators, and a large share of the general public who are not aware of its distinctive properties. Tempered glass has its surfaces in compression to a much higher degree than ordinary annealed glass. For large flat sheets the compressed layers extend about one fourth of the way in from each surface and are offset by the center layer in tension. Tempered glass is more than 4 times as strong as annealed glass and can be bent and twisted much further before the compression on one of the surfaces is offset by tension large enough to cause fracture. It can also withstand several hundred degrees of thermal shock. When breakage does occur, the entire article disintegrates into small cubes.

During a soak period temperatures were equalized throughout the load by conduction and radiation. Glass cannot be soaked more than a few seconds at the final temperature required for tempering because it is soft enough to wrap or flow around the supports. Therefore, all parts of the load of glass must be heated at the same rate to arrive at the same final temperature at the same time and then be rapidly transferred to the quenching mechanism. The tempering was further complicated by the fact that the glass must be supported by metal while being heated and quenched and that the difference in heating and cooling rates between glass and metals severely limited the designs of supports that can be used.

At one time the only practical way to hold sheets of flat glass for tempering was by tongs, similar to ice tongs, with which the gripping pressure was created by the weight of the glass being supported. If the glass became overheated and soft owing to inadequate control, its own weight kept it in a flat vertical plane, provided the tong points which touched the glass and the tong supports were all in perfect alignment.

It was, therefore, desirable to support the glass by means other than tongs. Racks having hairpins over the top edges to keep the plates vertical and having supports along the bottom edges were developed. Today, it is possible to temper television implosion plates 20 inches high by 25 inches long by ¼ inch thick on racks with a near perfect yield and less than 1/16 inch warpage.

The first improvement needed to achieve this improved result was in the temperature control. The off-on type of control in use on electric furnaces and radiant tube gas furnaces was entirely inadequate. The temperature had to depart from the control point before corrective action would be taken. The first improved controller to be used by the author was a homemade device which turned the heat off and on 10 times as fast as the old control. The temperature did not vary appreciably during these short cycles. The device was also able to anticipate demand after a change of load and slowly approach the control point without overshooting. It also had automatic droop correction so that after a change of demand the original control point was gradually restored. Besides improving yields by reducing variations in final temperature, these controls made faster heating cycles possible by reducing the soak time formerly necessary to average out temperature swings.

Glasses having different colors or heat absorbing abilities, chemical compositions, softening points, and thermal expansions must also be kept separate and treated under special conditions for best results.

Furnace designers have been striving to improve the uniformity of temperature over large areas of glass. Electric furnaces can be divided into numerous small areas, each having its own temperature control. The heating elements can be close to the glass to localize the effect of each zone. Gas fired furnaces having numerous small burners each controlled by a gas cock connected to a common manifold which in turn is regulated by a single temperature controller also make it possible to increase or decrease temperatures in selected areas. Since there is always a volume of cold air near the floor of the heating chamber owing to air infiltration and settling of air cooled by the load, more heat should be provided in this region. Circulating fans will also help to equalize air temperatures. Tight seals and heavy, uniform insulation have been found helpful.

Although much progress has been made in the last decade in tempering techniques, much remains to be done, and we can look for even greater progress in the next decade with lower costs and more widespread uses of tempered glass until everyone is familiar with its properties.

The next paper was "Production of High Melting Glass Fibres," by Alexander Silverman, University of Pittsburgh, Pittsburgh, Pennsylvania. Professor Silverman spoke of a preliminary study of phase diagrams, especially those in which there were high temperature liquidus areas for individual substances or mixtures and also of the melting points of compounds and minerals in the high range.

These materials were then mixed in finely divided form with a binder and were extruded by means of a screw feed. The continuous rods were heated as they descended, first drying and then baking. After baking they were subjected to high temperature flames which melted them instantly. Then they were drawn either into fibers or blown into staples.

Bulk fibers have been produced that are stable for several days at 2350°F. and are still in perfect condition 3 years after their production. It is expected that fibers will be produced that have melting points up to and above 5000°F. The author pointed out that the strength and durability of glass fibers usually increased with the melting point of the substance, with the higher melting fibers being the most durable and the strongest. The talk was illustrated with lantern slides and specimens.

The final session on Friday morning was led by H. E. Walker, Harding Glass Company, Fort Smith, Arkansas. The first paper was "Dimensional Control in the Manufacture of Glass Containers" by Vaughn L. Ritter, Armstrong Cork Company, Dunkirk, Indiana. This problem has been a serious one for many years for the container industry. Unfortunately, molds alone do not offer complete control but do offer a start.

Corkage, cap-fit and volume are factors of control, while bottling machines have been vastly improved. The paper traced the historical development and improvement of the bottling machine.

Packing-line speeds were formerly 100 per minute, but today they have increased to 1000 per minute. Speed has to be regulated from maximum to minimum, but the ideal average to produce high-type ware is usually allowed as the ideal for good packing-line performance. Once desirable size has been ascertained, the ideal is strived for rather than maximum or minimum achievements. The necessary periodic mold inspection, for example, should be made on the basis of ideal measurement rather than maximum or minimum. The closer the ideal is attained the less likely it is to exceed the extremes in either way.

In many packing lines the width of container is more difficult to control than the height. Dimensional control of finish is desired because the cap must fit correctly and seal the container. Good sealing is of maximum importance and cap application is one of the user's important criteria. The housewife is first interested in knowing whether or not the cap is going to fit and proper sealing is going to be effected.

The capacity may be highly important where taxes are involved. Again, the average capacity near the ideal is the best criterion.

An example of ⅛ oz. error, in a particular container, produced a loss of over $500 in one hour to the supplier.

Measuring equipment, such as gang gauges and automatic inspection, were discussed as well as the frequency of inspection. The method and tools used were pointed out as being as versatile and as varied as individual ideas. The need for and progress of dimensional control have increased during the past 40 years, and greater emphasis will be noted in the future as more accurate containers are made.

The next paper, "Applications of Glass Property Measurements to Glass Forming Operations," was presented by D. A. McGraw, Owens-Illinois Glass Company, Toledo, Ohio.

The next paper was "Influence of Physical Characteristics on Glass Melting Processes and Quality" by James P. Pool, Brockway Glass Company, Brockway, Pennsylvania.

Particle size distribution of the raw batch materials is known to affect (1) batch mixing, (2) melting and firing and (3) refractory life. In general, particle size of batch should be devoid of large particles (greater than 15 mesh) and contain only a small fraction of real fine (200 mesh). The extremely fine particles are particularly to be avoided.

Segregation of the batch as determined by an electrical conductivity technique and expressed as free alkali in the batch was shown to indicate a variation of grain size in the raw materials delivered to the tank. The amount of Na_2CO_3 was shown to be as high as 80 pounds variation per ton of batch.

The use of a moist batch 4-5 per cent H_2O was found to improve greatly the uniformity which resulted in numerous advantages and improvements in melting. The moisture was added at the mixer by spraying. The moist batch was also believed to provide less cordy glass, less volatilization, also less carry-over into the checkers with less corrosion of refractories.

Carry-over into the checkers was collected periodically and analyzed. The analysis was as follows:

SiO_2	20.42 per cent	Na_2O	53.53 per cent
R_2O_3	4.94	K_2O	.45
CaO	15.38	S	.17
MgO	1.37	F	1.45
BaO	1.97	MnO	.26

Tunnel debris was also collected periodically and analyzed. A typical analysis follows:

SiO_2	11.9 per cent	Na_2O	32.5 per cent
Al_2O_3	.5	K_2O	5.2
CaO	1.1	SO_3	46.0
MgO	1.9		

Improved control of melting procedure and better regulation of the physical characteristics of the glass can be maintained by careful particle size distribution of batch and the use of moisture (4-5 per cent) in the batch.

The next paper, "Glass Making Material Problems on the West Coast", was presented by George J. Loeffert, Glass Containers Corporation, Los Angeles, California. Raw materials for glass manufacture occurring on the Pacific coast were discussed and their influence on the glass industry of that area was shown. The two areas of importance are San Francisco and the Oakland Bay area in Northern California and the Los Angeles area in the southern part of the state.

The sands used are of two types: (1) in which SiO_2 is quite high, 99 per cent + and (2) feldspathic sands which contain appreciable amounts of Al_2O_3 (11-13 per cent). These unusually high Al_2O_3 sands provide glasses that demand some alteration in furnace design and especially forehearths as well as mold design. Many refinements and improvements in sand beneficiation have been made which include washing, scrubbing, flotation and magnetic separation.

Soda ash is obtained largely from Trona in the Mojave desert. Two types are produced, one, in a very pure form and another type in a form containing B_2O_3 and sulfate as impurities. Calcite limestones, containing about 0.04 per cent Fe_2O_3, are abundant and of good grade. The glass raw materials on the Pacific coast are quite abundant and versatile and are in ample supply for an expanded industry.

The final paper, "Trends in Glass Making Soda Ash," was presented by G. A. Gregory, The Solvay Process Division, Allied Chemical and Dye Corporation, Syracuse, New York. This paper traced the development of the soda ash industry from its advent in the United States about 70 years ago to the present day. The physical characteristics of the material are most important especially its grain size. The ideal condition is approached by eliminating the extremely fine and extremely coarse particles and estimating that the average sizes in between approach that of the sand being used in the batch. As a rule, there is a tendency to have grain size a little smaller than the sand. Proper grain size distribution permits a close setting of furnace operations and ultimate closer control of manufacture, especially the melting of the glass.

Modern soda ash manufacture utilizes the Solvay process which requires large quantities of salt, limestone, carbon dioxide, and ammonia. The present process provides a very pure product that is free from iron, carbon, or sulfates. The result has been that glass difficulties, such as cords and stones, are kept at a minimum. The more important developments in this industry have centered around the production of varying grades of soda ash to meet varied requirements of the industry with emphasis on the elimination of the extremely fine particle size.

In 1935, there were seven recognized grades of soda ash available to the glass industry, but today three principal grades are recognized. They are No. 1 dense regular, No. 1 dense coarse, and No. 2 dense—all of which emphasize a controlled grain size. The finer fractions probably receive the greatest attention because carry-over into checkers, burner parts, and flues is not desired.

Emphasis was placed on the desirability of obtaining a recognized ASTM Standard for the industry.

On Thursday evening a dinner was held at the ballroom of the Deshler Hilton Hotel. Professor Fay V. Tooley, University of Illinois, Urbana, Illinois, was toast-

(*Continued on page* 50)

Phase Separation Induced by Platinum in Sodium Phosphate Melts

By G. E. RINDONE and R. J. RYDER

Department of Ceramic Technology
The Pennsylvania State University, University Park, Pennsylvania

ABSTRACT

The introduction of 0.002 per cent to 0.006 per cent by weight of colloidal platinum into a sodium metaphosphate melt leads to a crystallization of the melt upon cooling. An electron microscope examination of the glasses reveals that the platinum first causes the melt to separate into two liquid phases before crystallization occurs. The phenomenon is interpreted on the basis that the sodium phosphate melt consists of at least two basically different structural groups which become unmixed in the presence of platinum particles.

INTRODUCTION

The interaction of the platinum metals with molten glass has been the subject of a series of investigations conducted in the Department of Ceramic Technology of The Pennsylvania State University for several years. Interest in this field arose as a result of the lack of systematic information on the coloration which can be imparted to glass by these noble metals which are so vital to the production of high quality glass.

Platinum and its alloys have been used for linings of glass tanks and for crucibles because of their inertness to the corrosive action of molten glass. The studies reported by Rindone and Rhoads[1], and Ryder and Rindone[2], have shown, however, that these metals can produce strong colors even when present in very low concentrations. In addition, the presence of submicroscopic particles of platinum leads to light scattering and in some cases to devitrification.

In particular, it was shown that by means of platinum nucleation, a sodium metaphosphate glass can be induced to devitrify under conditions where devitrification normally does not occur. The platinum is introduced into the batch as a platinum chloride solution and reduces to the finely subdivided metal upon melting. In Figure 1, a series of sodium metaphosphate glasses is shown, all of which were melted and cooled under identical conditions. Only the amount of platinum was varied. The first glass containing no platinum is clear and colorless. With platinum concentrations from 0.0005 per cent to 0.001 per cent by weight, the glasses are gray, whereas in concentrations of 0.002 per cent to 0.006 per cent platinum they are gray and devitrified.

Fig. 1. Devitrification Induced by Colloidal Platinum in Sodium Metaphosphate Glass.

College of Mineral Industries, Contribution No. 56-31.

A further study has been made of this phenomenon with the aid of the electron microscope and X-ray diffraction analysis. It has been found that platinum induces the sodium metaphosphate glass to separate into two liquid phases before devitrification occurs.

Electron Microscopy

The technique for obtaining electron microscope photographs was as follows: Replicas were made of freshly fractured surfaces of the glasses by first evaporating platinum onto the surface and then backing up the platinum with evaporated carbon. This is known as the preshadowed carbon replica technique. The replica is removed from the glass surface by dissolving the glass in water, after which it is placed on a 200-mesh screen over a thin layer of collodion for support.

Using this technique, glasses with and without the addition of platinum were studied. In the absence of platinum, there is no evidence of phase separation or crystallization (Figure 2). With the first additions of

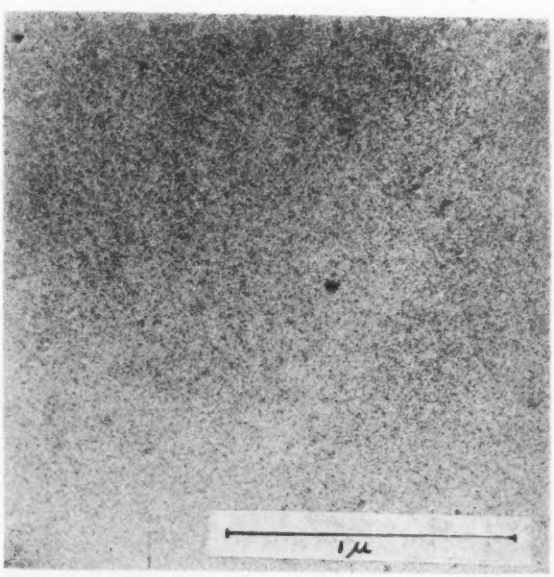

Fig. 2. Electron Micrograph of Sodium Metaphosphate Glass Without Platinum.

platinum where the glasses are colorless to gray, droplets of a liquid phase which have separated from the molten glass are formed. These are shown in Figures 3 and 4 where the platinum concentration is 0.001 per cent. Platinum particles can be seen within many of these droplets. Edges of the hexagonal platinum crystals can be clearly distinguished in some cases. The area surrounding the rim of the larger droplets reveals a swarm of many smaller droplets which have not yet coalesced into the larger droplet. The droplets vary in diameter from below 1000 Angstroms to one micron. With higher platinum concentrations where devitrification occurs, both droplets (Figure 5) and crystals of the devitrified glass (Figure 6) can be seen. The black areas are platinum crystals which have remained on the replica after the glass was dissolved away. Their hexagonal shape is clearly visible.

It can be seen, therefore, that the platinum nuclei cause the glass melt to separate into two liquid phases and, enhance the devitrification of the melt.

X-Ray Diffraction Analysis

X-ray diffraction analysis has shown that the phase crystallizing from the glass as a result of platinum nucleation is not identical with that obtained by devitrification without platinum. When devitrified at 500°C., the platinum-free sodium metaphosphate glass consists primarily of Form I $NaPO_3$ although some unidentifiable phases are also present. When nucleated with platinum, the crystalline phases give a different X-ray diffraction pat-

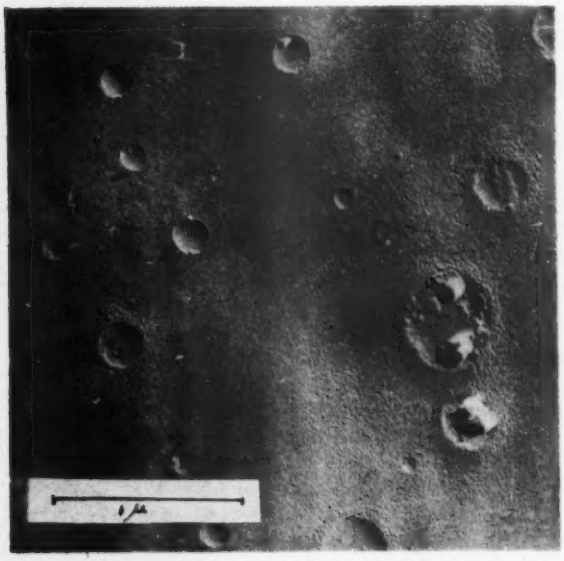

Fig. 3. Phase Separation in Sodium Metaphosphate Glass with 0.001% Pt.

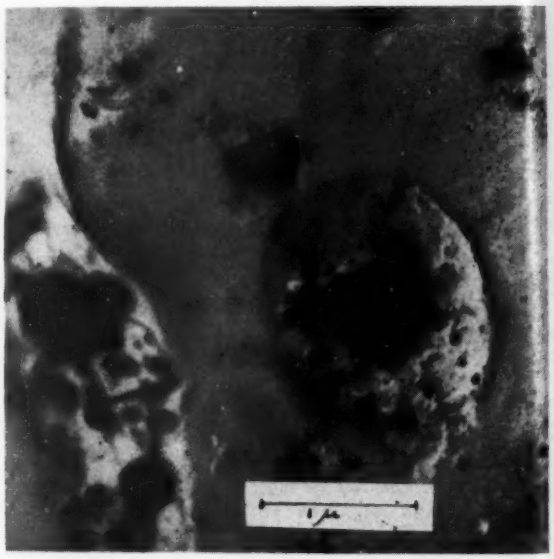

Fig. 5. Phase Separation in Sodium Metaphosphate Glass with 0.002% Pt.

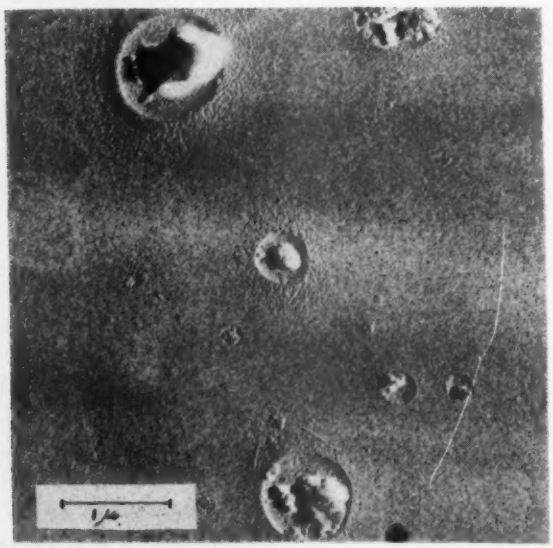

Fig. 4. Phase Separation in Sodium Metaphosphate Glass with 0.001% Pt.

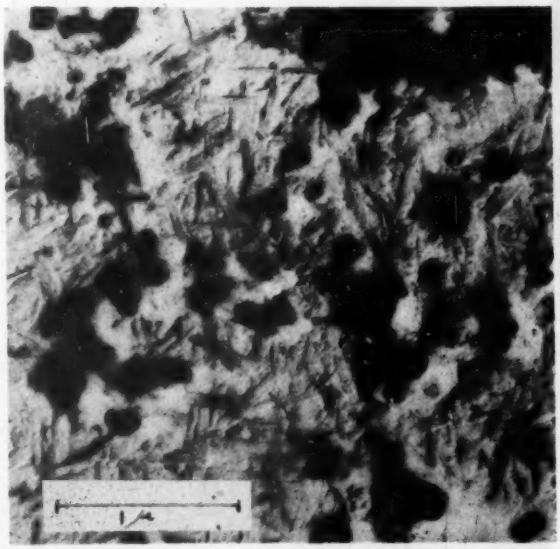

Fig. 6. Crystallization in Sodium Metaphosphate Glass with 0.002% Pt.

tern. It has not been possible to identify these crystals using known sodium phosphate diffraction data.

Discussion and Further Experiments

Karkhanavala and Weyl[3] have demonstrated that noble metals such as palladium can serve as nuclei for liquid phase separation in the system Li_2O-SiO_2. This phase separation occurs above the liquidus temperature of the melt. Consequently, nucleation occurs here under equilibrium conditions and not under the same conditions as when rate phenomena are involved. The explanation for the nucleated phase separation in the lithia-silica system and in the sodium phosphate melts may both be based on the same reasoning.

In both cases the structure of the melt could consist of basically different groups which are continuous with one another. These groups may consist of different ratios of alkali to glassformer. In order for the groups to grow sufficiently to form an interface, the free energy of the system would have to be lowered by the process. In the absence of colloidal platinum, the energy gain by the formation of larger groups is not high enough to overcome the loss of entropy by unmixing because the temperature of the system is well above the liquidus curve. The situation is changed in the presence of platinum. One of the groups is preferentially adsorbed by the platinum leading to a growth in the size of the groups and, consequently, to phase separation.

According to Forland[4] this phenomenon may be interpreted on the following basis: The total heat of adsorption of the phase on the platinum must be small because the amount of platinum added is small compared to the amount of phase which separates out. Since this small change in the total heat content of the system can cause an unmixing, this would indicate that the change in entropy of the system by unmixing is small. A small change in entropy would mean that the platinum-free melt must contain a degree of order which is nearly the same as the platinum-nucleated melt.

Nucleation by noble metals leading to crystallization is well known, particularly as the basis for the photosensitive glass process[5]. The question arises with respect to the sodium metaphosphate glasses as to the relationship between the liquid phase separation and the crystallization.

Further experiments were performed in an effort to explain the mechanism. Sodium phosphate glasses were studied with platinum additions in which the Na_2O/P_2O_5 ratio varied slightly below and above unity. Platinum nuclei were introduced into the composition 0.55 Na_2O.0.45 P_2O_5 and into an ultraphosphate having the composition 0.47 Na_2O.0.53 P_2O_5. Table I compares the crystallization tendencies of these glasses with that of the sodium metaphosphate glass.

Less platinum is required to crystallize the sodium phosphate glasses as the Na_2O/P_2O_5 ratio increases from 0.89, 1.0, to 1.2. Crystallization begins with 0.05 per cent, 0.002 per cent and 0.0005 per cent platinum in the respective glasses. In other words, platinum is more effective as a nucleating agent leading to crystallization as the Na_2O content increases.

These experiments offer an explanation as to why crystallization of the sodium metaphosphate glass occurs after the liquid phase has first separated out. If it can be assumed that the liquid phase which separates out by adsorption on the platinum particles is richer in P_2O_5 than the remainder of the melt, then the Na_2O/P_2O_5 ratio of the remainder of the melt increases. Thus, as more platinum particles are furnished, the Na_2O/P_2O_5 ratio is shifted to higher values because more of the P_2O_5 rich phase is withdrawn. In the glass where the ratio Na_2O/P_2O_5 is 1.2, less platinum is required for crystallization because only a small removal of P_2O_5 from the melt is sufficient to shift the composition to higher alkali contents where crystallization is more likely to occur. On the other hand, much more phase separation is necessary in the phosphate glass with a Na_2O/P_2O_5 ratio of 0.89 to remove sufficient P_2O_5 to alter the melt composition enough to cause crystallization.

Significance of the Results

The fact that platinum nuclei can separate an apparently homogeneous melt into two liquid phases has important theoretical significance. Today, there is much controversy as to whether the structure of glass consists of a random network or of discrete groups sometimes referred to as micelles. It should be possible to determine which glass systems contain micelles by nucleating them with platinum or other noble metals. If these micelles

(*Continued on page* 51)

Table I

CRYSTALLIZATION OF SODIUM PHOSPHATE GLASSES WITH PLATINUM

Platinum Conc. (wt. per cent)	0.47 Na_2O·0.53 P_2O_5	Na_2O·P_2O_5	0.55 Na_2O·0.45 P_2O_5
Ratio Na_2O/P_2O_5 :	0.89	1.0	1.2
none	glass	glass	glass
0.0005 per cent	glass	glass	crystallized
0.001	glass	glass	
0.002	glass	crystallized	
0.004	glass		
0.005	glass		
0.006	glass		
0.008	glass		
0.01	glass		
0.05	crystallized		

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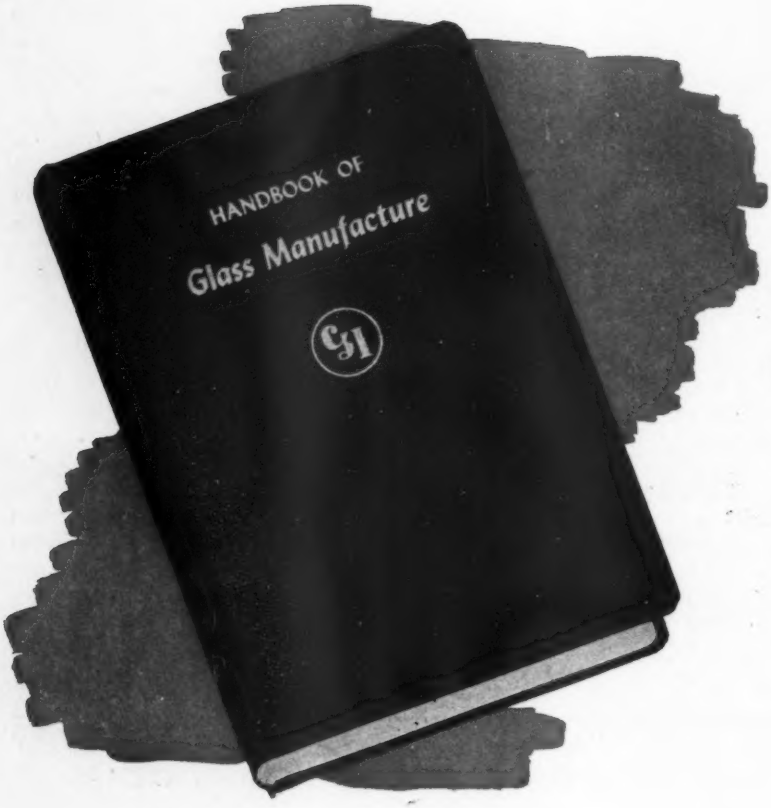

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The Handbook of Glass Manufacture is the only book of its kind, and for all who are engaged in glass manufacture and those who serve the industry —it continues to be as necessary as sand in the batch.

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Without interruption the demand for copies of the Handbook has continued and it is for this reason that we decided to bring out a second edition of the book. This second printing, identical in content, format and binding, will be off the press within sixty days.

The continued demand for the HANDBOOK OF GLASS MANUFACTURE proves that it has filled an important role as a practical working tool for *glass plant executives, research heads, laboratory technicians, engineers and technologists.*

THE NEW HANDBOOK OF GLASS MANUFACTURE is comprised of more than 500 pages of practical reference data—tables, charts, formulae, illustrations, and text—on all phases of glass manufacture. Each section has its own table of contents, in addition to the master table. A comprehensive index provides quick reference to the contents of the entire book.

Basically, the HANDBOOK OF GLASS MANUFACTURE is intended to give those engaged in glass manufacturing operations a starting point, or point of orientation, with respect to particular problems confronting them. By becoming familiar with materials, apparatus, equipment, and principles relating to a given problem, and with points of view that have proven successful on similar problems in the past, this new Handbook should enable those who use it to get off to a better start in solving a given problem.

It is a primary working tool for plant executives, research heads, laboratory technicians, and engineers. It is complete enough to be used as a text or reference work for a course in glass technology. It can also be used effectively by glass companies as a source of reference to many of their customers and others who wish to obtain a general knowledge of glass manufacturing.

• • •

This new handbook is the product of many individuals, each one particularly qualified to handle the subject assigned to him—a truly collaborative effort. Those who have made this book possible and their subjects appear in the opposite column.

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Safety Planning in Diversified Industry

By THOMAS R. DONOGHUE

Manager, Safety and Plant Protection
Pittsburgh Plate Glass Co., Pittsburgh, Pennsylvania

• Last year was a banner year safety-wise for Pittsburgh Plate Glass Company. Our company's lost-time accident frequency rate of 5.3 per million man-hours worked was the lowest rate ever achieved by Pittsburgh Plate during the 35 years for which safety records have been maintained.

The record frequency rate was computed on the 49,947,726 man-hours compiled by slightly more than 25,000 men and women employed in the 45 nationwide industrial units of Pittsburgh Plate, Columbia-Southern Chemical Corporation, a wholly-owned subsidiary and Pittsburgh Corning Corporation. In addition, Pittsburgh Plate's 1955 severity rate of 477, which is computed on the number of days lost per million man-hours worked, was our second lowest since the all-time low severity rate of 423 was established in 1949.

These statistics reflect only the bare facts of the end-result of vigorous and continuing accident prevention activity over the past three and a half decades. Thousands of dollars have been spent during this period to establish a program in which today employees and management work together as a cooperating team to maintain company safety and a smooth functioning production system.

How is it possible for a company with so many diversified production interests as we have to attain such a record? What comprises a sound safety program? How does it function? Where does it begin and end? Who is responsible for making it work, These are only a few of the questions that are correlated and finally resolved into a practicable safety program tailored to suit our diversified needs.

In diversification, occupational hazards are multiplied many times. Being diversified as we are at Pittsburgh Plate—glass, paint, chemicals, brush, coal and cement—it is essential that a company-wide safety program be adopted to maintain safety and welfare of personnel. We have been quite fortunate in that our top management has not only expressed an interest but has been an active participant in promoting safety practices for employee welfare from our major manufacturing units all the way down to the company's end-products distributors.

The spirit of our safety interest and program had its origin as far back as our affiliation with the National Safety Council in 1916. However, it was five years later that our broad formalized safety program first took shape at our Crystal City, Missouri, plate glass manufacturing plant. At that time our company inaugurated its safety committee system consisting of a general committee of top management personnel and departmental committees which met in regularly scheduled sessions.

We have since devised from this nucleus a broad safety program which has been adapted to serve effectively in any of our aforementioned diversified operations. In each plant of these divisions we have a safety organization supervised by an executive safety policy committee. The general safety pattern and the scope of coverage for each unit is determined by the size and type of operation involved.

As our diversified interests increased, our safety organizations expanded from a mere handful in 1919 to the present 45 units with each varying in total employees ranging from 50 to 4,000. The philosophy of the importance of safety of the individual has since been restated and reemphasized many times.

In a diversified industrial operation such as ours there is always the problem of expansion. It is our policy to immediately stress safety as soon as a new unit has been brought into our organization. This program is formulated as quickly as possible to establish safety as a primary part of our daily operations.

A case in point is our new ultra-modern plate glass manufacturing plant at Cumberland, Maryland, which began partial production last September. Behind the initial flow of rough plate glass, months of planning were spent in the preparation of a safety program designed to keep pace with modern plate glass manufacturing techniques.

Several months prior to the beginning of production, plant management personnel attended our training department's induction and orientation conferences for three weeks. During this period individuals were indoctrinated on the principles of plant safety policy, program and organization. In addition, they received training in first aid and medical programs, fire prevention, plant protection and good housekeeping. As major construction still continues in the main glass producing areas and around the plant site, safety preventive measures are being planned and carried out daily.

At our Cumberland plant, as in each of the other industrial units, Pittsburgh Plate's safety program is fundamentally based on a clear-cut statement of policy, a sound organization and effective communication of safety information between supervisor and workers. In support of these fundamentals, it might be stated that the specific factors which have been instrumental in the successful operation of our safety program are namely:

(1) Executive safety policy committee
(2) Supervisory safety meetings
(3) Departmental meetings or employee contact plan
(4) Poster program
(5) Good housekeeping program
(6) Fire prevention and protection

(7) Physical examination
(8) Supervisory safety conference
(9) Safety induction program

Keystone of Program

Now that our Cumberland plant has begun production, the primary responsibility for administration and direction of the safety program and organization falls upon the plant manager. He directs the program through an executive safety policy committee, of which he is chairman. This committee, which is the keystone of the entire plant program, consists of superintendents of various operating sections of the plant; the industrial relations director and the director of safety and plant protection.

Meeting once monthly, this advisory group initiates, organizes and directs safety policies, program additions or changes. Also, the committee's agenda includes for review such items as plant accident record, serious plant hazards, recommendations from area supervisory groups, introduction of new visual aids, new package training programs, good housekeeping reports, fire prevention or fire protection problems and other related safety topics.

Within the Departments

Each department has its own supervisory safety committee of which the superintendent, a member of the plant executive safety committee, is chairman and on which foremen serve. Following closely and monthly on the heels of the executive committee meeting, the area supervisory sessions provide an opportunity for a review of the former's meeting along with discussion of all departmental inspections, accidents, injuries and other pertinent safety problems within its area, referring more serious and plant-wide inquiries to the executive group.

To complete the plant's chain of communication in the line safety organization, every supervisory member of all area committees conducts at least one meeting monthly. These either may take the form of committees or at which the entire personnel of the department may be present. Here again subjects related to the safety or fire prevention programs may be included on the agenda, however, this committee emphasizes that line supervision is responsible for the safety of the individuals under its care.

Supervisor Is Key

The role of the supervisor cannot be emphasized enough. He is the key man in our chain of communications and on whom rests tremendous responsibility for the success of our safety program. He carries the company's accident prevention program directly to the work place of each employee. Unless he fully understands and accepts the responsibility to make his department safe and free from injuries—all else is so much talk and waste motion. If the supervisor recognizes and accepts responsibility for reporting, inspection, first aid, job safety instruction, accident and near accident investigation, enforcement of safe practices and protective equipment and all the details of safe conditions, it is possible to attain a successful safety program.

Supervisors at each of our plants are responsible for the safety training of all employees. Safety training must be constant—on the job, day-by-day contact, particularly so where the establishment and instruction on safety rules apply to the specific operation or equipment in use. His alertness to every hazard and especially to the problems of housekeeping in his department are among his many responsibilities, which, when performed diligently, contribute largely to the overall plant safety program.

Several invaluable aids designed to assist the supervisor in conducting his phase of the safety training program are the contact and observation plans. In the former, the supervisor contacts at least two employees daily for a period of three to five minutes on job safety. The contact plan is only another of our continuing endeavors to promote the "live, think and act safety" theme among employees.

Meanwhile, the observation plan has been instituted as part of his daily routine for the purpose of striking at unsafe practices *before* not *after* an injury, fire or accident. It serves a two-fold purpose, namely, (1) to detect and eliminate unsafe practices before an accident is caused by reason of such practices and, (2) to instill in all supervisors the *habit* of being on constant guard against unsafe practices, by spotting and eliminating them immediately. Check lists and departmental safety inspection report forms help make his inspection under the observation plan a more efficient and accurate one.

Organizing safety committees is, of course, not of itself sufficient enough to assure a satisfactory safety program. Cooperation both from a management and employee standpoint is of utmost importance if the committees are to function smoothly and efficiently for the safety and welfare of company personnel. In this regard every effort is made to make employees safety conscious both on and off the job. Visual aids, guidance programs and complete counseling service are vital facets in each of our plant safety programs.

Employees Indoctrinated

The induction of all new employees for both office and plant is an essential responsibility of the safety department. New employees receive safety instruction

One of every three industrial injuries is due to poor material handling—mechanically or manually—from one spot to another. Above is a demonstration illustrating the correct procedure for lifting material manually.

in a regular indoctrination program immediately after their selection. We, at Pittsburgh Plate, provide the background for and commence the continuing safety training of each employee in safe work methods, accident and injury prevention, housekeeping, fire prevention and protection. Also, we emphasize the joint safety responsibility of all employees with management, create the desire to be safe workers and impress them with the concept that a safe worker lives safety not just eight hours but 24 hours a day—both on and off the job.

The safety phase of our induction program is accomplished through the "vestibule" and the "departmental" sessions. In addition to our training department's induction program, the new employee, before being assigned to his department, is schooled by the safety department in general safety rules of the plant, proper lifting technique, reporting injuries, appropriate visual aid, personal protective equipment used in the plant, and other essential safety points deemed necessary.

In departmental induction, the new employee is given a tour over at least a section of the plant after which the department supervisor stresses (1) departmental rules, (2) reporting injuries immediately, (3) product quality, (4) reporting unsafe conditions and, (5) reviewing other salient safety practices. Following this briefing on department hazards, the new employee is then trained in "on the job" safety during which time rules pertinent to personal habits are emphasized, thereby reiterating that safety is primarily a personal responsibility. Making the employee feel he is a *part* of instead of *apart from* the safety program is important to our accident prevention program.

Along this line, we have endeavored to develop safe work habits on the part of employees through our program of education and training. As part of this continuing effort, poster programs and plant housekeeping are vitally important in getting the employee interested in freedom from accidents. Posters, which are displayed every two weeks, are designed to make employees safety conscious on and off the job. Good housekeeping campaigns are stressed to assist in providing a safe working environment. A well-organized plant housekeeping program leads to safety and efficient, economical production; conversely, with poor maintenance it is hard to conceive of safe working conditions.

Housekeeping Program

At Pittsburgh Plate, our housekeeping and safety inspection committee consists of two members from the executive safety policy committee, one of whom is replaced monthly, and the director of safety and plant protection who is a permanent member. Competition between departments stimulates thinking as well as action and goes a long way toward bringing about improvement. Making an inspection and rating a department is not in itself sufficient. Inspectors make written reports of unsatisfactory conditions and these reports are then followed up by the supervisor of the department. These reports are also included on the agenda of the executive safety policy committee.

Another important segment of the plant safety program is fire safety. We impart to each employee in the plant a knowledge of, and interest in, the fundamental principles of fire prevention and elementary fire fighting. In addition, department and plant-wide fire brigades are organized and trained not only for fire duties but also to perform in emergency capacities. Plant housekeeping is important to all. A familiar adage, "a clean plant seldom burns," pretty well sums up the importance of good housekeeping that we attach to plant fire safety. Pittsburgh Plate Certificates of Honor for perfect safety calendar years as well as Certificates of Merit for progress in safe plant operation over the preceding year are awarded annually to plant personnel in recognition of their safety accomplishments.

First Aid and Medical Program

The company's physical examination phase of the medical program is established and is followed up to the extent that professional services are provided when requested. The pre-employment physical is very thorough, consisting of urinalysis, blood serology, chest and back X-rays, hearing, sight and a complete strip physical examination. Physical examinations for new, current and sick employees require constant evaluation according to a company policy governing such activities. Periodic check-ups of employees on specific jobs are required as established by the medical department. A nurse is on duty for every shift in the plant. Members of the plant protection department are trained in simple first aid so that they may aid the medical program at requested times.

Supervisory Conferences

Plant supervisors, in a group of 12 to 18 individuals, attend monthly conferences for the purpose of reviewing safety presentations, policies, problems and training in keeping with our supervisory training program.

Plant Protection Department

Members of the plant protection department which is part of the safety department consist of a plant protection supervisor and two employees per work shift. They have the broad responsibility for alertness and action against acts or conditions which contribute to fires, explosions, accidents, injuries or other hazards. They are also interested in the security of company and employee property.

All members of the plant protection department are deputized. Plant protection personnel are under the administration and supervision of the director of safety and plant protection, and the direct and immediate supervision of the plant protection supervisor of the work shift. They make many fire prevention and accident prevention inspections and reports; also check employees identification, clock punching procedures, visitors, trucks, and notify employees in the event of home emergencies.

Plant Protective Equipment

In each of our manufacturing units the safety program is designed to cover the exposures of the particular processes involved and to afford maximum protection to exposures which cannot be guarded against mechanically by furnishing the very newest and best in protective clothing and equipment.

Through the years Pittsburgh Plate Glass Company has shown safety leadership by developing a major part

(*Continued on page* 42)

Inventions and Inventors

Annealing and Tempering

Heat-Treating Frangible Glass Articles. Fig. 1. Patent No. 2,754,628. Filed April 15, 1953. Issued July 17, 1956. Four pages drawings. Assigned to J. O. Ross Engineering Corp. by Allen S. Dawe.

This invention relates to the controlled cooling of relatively large irregularly-shaped glass envelopes such as the envelopes of television tubes.

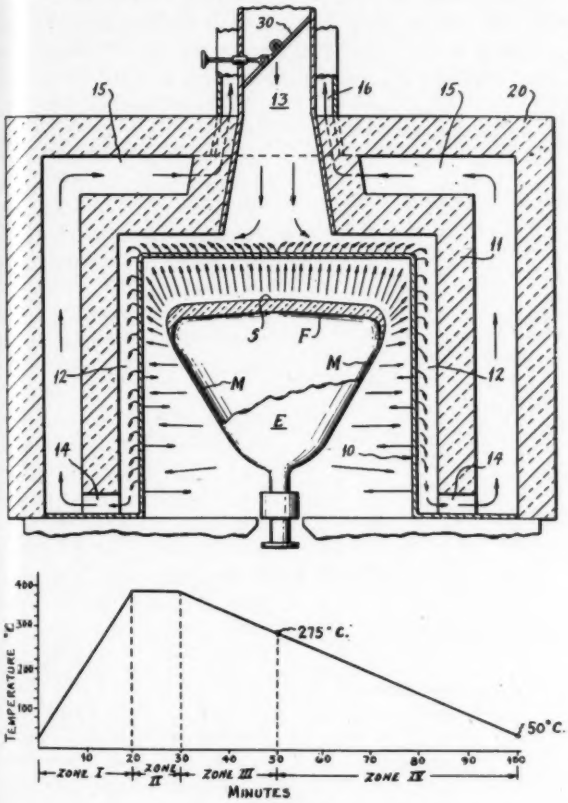


Fig. 1

Desirable results are accomplished according to the method of the invention and with the apparatus shown schematically in Fig. 1 where the envelope E, having been baked in zone II at a temperature on the order of 400°C., enters the cooling zone. The cooling zone III and subsequent cooling zone IV are jointly provided in the preferred apparatus by a metal wall tunnel 10, through which a series of envelopes E are conveyed progressively from the heating of zone I through baking zone II immediately preceding cooling zone III, which is depicted in Fig. 1.

The cross-sectional shape of the tunnel 10, generally conforms to the contour of the envelope E, i.e., the tunnel 10 is generally rectangular opposite the relatively flat, thick walled spaced screen end S of the envelope E and is spaced relatively uniformly therefrom.

The tunnel 10 is enclosed in and surrounded by an insulating wall 11, which is spaced from the exterior surface of the tunnel 10 so as to form the relatively narrow passage 12. Leading downward, into the top of passage 12, is a cooling air duct 13, through which a large volume of cooling air is supplied. The space or passage 12 extends down the exterior sides of tunnel 10, to the bottom, to spent cooling air slots 14.

The cooling air entering passage 12, from duct 13, preferably is of room temperature and as it impinges against the horizontal upper surface of the tunnel 10, the cooling air stream divides and flows over the outer surface of the metal tunnel 10 to exhaust through lower slots 14 at either side. In view of the proximity and shape of the upper horizontal surface of the metal tunnel 10, to the relatively flat screen end S of the envelope E, the large volume of cooling air stream washing the upper surface of the tunnel 10 removes the heat absorbed because radiant transfer thereto from the screen end S, at a rate commensurate with the rate of emission.

There were 3 claims and the following references were cited in this patent: 1,510,556, Owens, Oct. 7, 1924; 1,804,657, Talbot, May 12, 1931; 1,951,950, Rising, Mar. 20, 1934; 1,981,560, Littleton, Nov. 20, 1934; 2,026,781, Geer, Jan. 7, 1936; 2,375,944, Quentin, May 15, 1945, and 450,464, Great Britain, July 17, 1936.

Feeding and Forming

Swinging Shear and Spray. Patent No. 2,754,627. Filed June 2, 1954. Issued July 17, 1956. Two pages drawings; none reproduced. Assigned to Owens-Illinois Glass Company by Robert R. Denman.

The invention relates to apparatus for spraying with a coolant and/or lubricating fluid and shears for severing molten or plastic material at a high temperature.

For this purpose the invention provides spraying means, combined with the shear mechanism in a manner to swing or move with the shear blades during a major portion of the shearing operation. The apparatus includes a pair of shear arms mounted to swing horizontally for moving the shear blades to and from the glass severing position. The invention provides spray nozzles mounted and arranged to move with the shear blades during a portion of their movement to and from the shearing position, thus increasing the length of time the spray nozzles are directing the spray material against the shear blades.

There were 10 claims and the following reference was cited in this patent: 1,864,277, Tucker et al., June 21, 1932.

Glassware Forming Mechanism. Patent No. 2,755,597. Filed November 30, 1951. Issued July 24, 1956. One page drawings; none reproduced. Assigned to Emhart Manufacturing Company by George E. Rowe.

This invention relates generally to the manufacture of hollow glass articles, typically bottles and jars, as accomplished by forming charges of molten glass into hollow parisons in parison molds, tranferring the parisons to final forming molds and blowing them to final form.

The object of the invention is to provide, in a compact conversion unit or "cartridge", the elements required:

(1) To position and guide the neck pin involved in parison blowing operations operatively in relation to a parison blow mold at an overhead parison forming station,

(2) To connect the neck pin operatively with the pressing plunger operating means of the form of mechanism given in Patent No. 2,508,890 when the pressing plunger has been detached from its operating means and the pressing plunger guiding and positioning elements have been removed.

(3) And to provide effective vacuum passages connecting the space in the lower or neck ring portion of the parison mold with an adjacent vacuum applying device to settle glass of a charge in the lower portion of the parison mold around the neck pin projecting into it.

The conversion unit utilizes fluid pressure connections and control means of the basic mechanism.

There were 9 claims and the following references were cited in this patent: 1,911,119, Ingle, May 23, 1933; 1,957,410, Miller, May 1, 1934; 2,075,363, Smith, Mar. 30, 1937; 2,091,238, Gordon, Aug. 24, 1937; 2,402,234, Berthold, June 18, 1946; 2,508,890, Rowe, May 23, 1950; 2,702,444, Rowe, Feb. 2, 1955, and 956,843, France, Feb. 7, 1950.

Glass Compositions

Glass Composition. Patent No. 2,756,158. Filed September 9, 1952. Issued July 24, 1956. No sheets of drawings. Assigned to Johns-Manville Corporation, by William P. Hahn and Edward R. Powell.

This invention relates to a glass composition, and more particularly to a glass composition which may be employed to produce stable glass fibers of very fine fiber diameter.

This invention consists primarily in a relatively narrow range of glass compositions which may be fluidized to proper fiberizing consistency, at a temperature substantially below that requiring apparatus elements fabricated from high temperature noble metals such as platinum, palladium, etc., yet, which will result in the formation of fine, long glass fibers which are moisture-stable and have an alkalinity value sufficiently low to meet the requirements of the U. S. Government Military Specification No. MIL-F-1228, dated September 12, 1949; that is, have an alkalinity value not exceeding 0.25 per cent Na_2O equivalent.

The glass compositions of this invention essentially comprise the following ingredients in the approximate percentages, by weight, indicated:

SiO_2	61-66
Alkali oxides	7-12
Alkaline earth oxides	5- 8
Iron oxides	5-12
B_2O_3	5- 8
Al_2O_3	5- 8

For best results, we have found that the iron component should comprise a substantial proportion, and preferably approximately 40-60 per cent, of iron oxide in the ferric state. It is satisfactory to introduce the iron as ferriferrous oxide or magnetite and preserve this oxidation condition through the glass making process. The iron oxides present, particularly in such a state of oxidation, apparently serve to stabilize the alkali oxides of the melt composition. This phenomenon is apparently due to the inhibition of reaction between moisture and free alkali at the fiber surface because of the presence, at the surface, of ferric ions.

There were 5 claims and the following references cited: 974,801, Kraus, Nov. 8, 1910; 2,308,857, Bowes, Jan. 19, 1943, and 2,582,852, Shoemaker, Jan. 15, 1952.

Furnaces

Homogenized Glass. Fig. 2. Patent No. 2,746,729. Filed August 5, 1952. Issued May 22, 1956. One page drawings. Assigned to Pittsburgh Plate Glass Company by Merle M. Eakins.

This invention is directed to homogenizing optical glass. It is concerned with a method of stirring to eliminate stria and cords resulting from the melting operation.

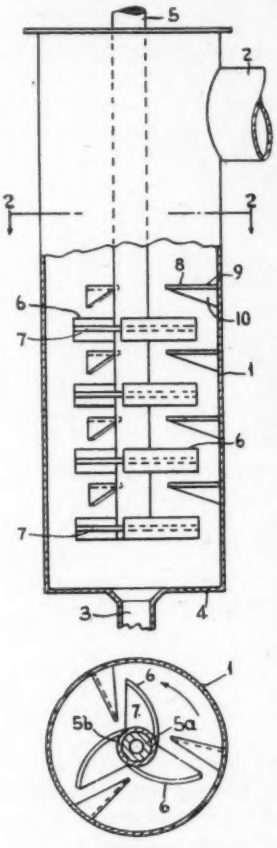


Fig. 2

Molten glass from a suitable melting and fining furnace (See Fig. 2) flows through inlet 2 into the cylinder 1 and out of the cylinder through the bottom outlet 3. The relative sizes of inlet 2 and outlet 3 are such that after the molten glass fills the cylinder 1 adjacent to the bottom side of inlet 2, the amount of glass within the cylinder is maintained throughout the period of operation. The top of the cylinder 1 is preferably closed to prevent surface cooling of the glass passing through and the level of glass within the cylinder must at all times be maintained at a sufficient height above the blade 6 to prevent air from being entrapped in the glass by reason of any turbulency set up above the blade 6, or the baffle members 8.

The temperature at which the glass is passed through the cylinder 1, or the volume of glass per unit of time, will vary with manufacturing conditions. The temperature of the glass, in the fining portion of the furnace, from which the cylinder 1 is fed will be about 2650°F. and varies depending upon the composition of the glass being melted. The glass upon entering the cylinder 1 and passing through to about the first abutment 8, will drop to about 2350°F., by supplying suitable insulation and heat to the cylinder 1 at the stirring blades 6 and abutments 8, the glass is preferably maintained above 2000°F. Preferably, the glass is not maintained in too fluid a condition since this impairs the attenuation of the stria. The rate at which the stirring

(*Continued on page* 49)

Research Digest

Influence of Water Immersion Treatment on Tensile Strength of Glass: Effect of Temperature

In earlier work the effect of water immersion on the tensile-strength of glass had been studied and it had been shown that such treatment increased this strength, the magnitude and rate of increase depending on the glass composition. Moorthy, Tooley and Stockdale (*Journal of the American Ceramic Society*, November 1956) now report results obtained by employing the same glass compositions, the same specimen preparation, and the same breaking technique but at water soaking temperatures of 60° and 30°C. for 24 hours instead of the earlier 90°C. temperature.

The effects of soaking temperature on the tensile strength are as follows:

(1) The borosilicate glass showed a gradual increase in strength as the soaking temperature increased. It was known from the previous work that the maximum strength is not reached at 90°C. for a soaking period of 24 hours.

(2) The soda-lime glass reached its maximum strength at some temperature between 30° and 60°C. No further increase in strength was noted at 90°C.

(3) The lead glass reached its maximum strength at some temperature between 30° and 60°C. No further increase was observed at 90°C.

The results show clearly that the increase in strength of glass due to water soaking is a function of both the time and the temperature of the soak. This is expected to be the case if the strength increase is brought about by the chemical action of the water on the glass surface.

An explanation of the data can be made on the basis of the flaw theory, although it is clearly recognized that further investigation may modify the interpretation. The action of the water on the glass surface is essentially chemical, causing decomposition of the glass and thereby exposing a new surface on which decomposition products are deposited. It is thought that the water attack on the flaws results in a diminution of their effect on strength. Rates of increase in strength diminish as the flaw healing mechanism is impeded by the formation of a protective layer of reaction products.

Soda-lime and lead glasses, being relatively less durable than the borosilicate glass, form a protective layer earlier in the process and hence the maximum strength is reached earlier. The borosilicate glass is probably much more difficult to homogenize and to manipulate during the melting and working; hence this glass might be expected to have a greater number of flaws compared with the other two types of glass. One would therefore expect to obtain a greater percentage increase in strength with the borosilicate glass; such an increase was obtained experimentally.

In the present work it was considered that some of the flaws, or zones of stress concentration, were produced during the preparation of the specimen, and that others were a consequence of extreme cases of disorder inherent in the natural structure of the glass. Fracture in glass was assumed to start at the surface and travel into the interior. When water reacts with the glass, an increase in strength results to the extent that the stress-concentration potential of the flaw is reduced by chemical action; the maximum strength is reached when the reaction products, such as silicate gels, build up a protective layer and impede this chemical action.

The spread noted in the control strength values of each of the glasses studied is typical for such strength determinations. The variation of the control strength may be due to any one or a combination of many causes. The temperatures and loads used in the two drawing operations have a significant effect. The care in handling and preserving the specimen before the test is another factor; humidity, dust, and fumes in the laboratory can alter the surface condition and can be expected to influence the strength. The diameter of the fibers, the diameter distribution in a set of fibers of the same average diameter and the shape of the constricted zone in the fiber are some of the other possible causes of the observed variation. Considerable care was exercised to control all of these factors and controls were used in each experiment.

Early work on the relation of the strength of glass fibers and their diameters indicated that a decrease in specimen diameter resulted in increased strength. Recent work introduced reasonable doubt as to the complete validity of this earlier concept of the strength-diameter relation. This view, however, does not completely invalidate the view of increased strength with decreased diameter based on the flaw theory and the probability of flaw occurrence but rather would seem to confirm it.

The force required to break a specimen may be considered to be counteracting the attractive forces in the specimen, viz., (1) the chemical bonds in the material which keep the structural units bound together and (2) the attractive forces residing primarily in the surface (the surface considered to be at least several ions thick). As the diameter of the specimen is increased, the attractive force due to the chemical bonds increases proportionally to the cross-sectional area of the specimen and the attractive force due to the surface effect is proportional to the circumference of the specimen. The breaking load for a circular specimen can be represented empirically as

Breaking load =
K times the cross-sectional area of the specimen +
Q times the circumference of the specimen

The tensile strength (breaking load/cross-sectional area) would be

$$T = K + \frac{4Q}{D} \qquad (1)$$

For convenience, setting $4Q = L$, the foregoing equation becomes

$$T = K + \frac{L}{D} \qquad (2)$$

(*Continued on page 52*)

Current Statistical Position of Glass

Employment and Payrolls. Employment in the glass industry during October, 1956 was as follows: *Flat Glass*s A preliminary figure of 31,100 for October, 1956 indicates an increase of 1.3 per cent from the adjusted 30,700 reported for September, 1956. *Glass and Glassware, Pressed and Blown*: An increase of 9.6 per cent is shown by the preliminary 85,200 figure of October, 1956 when compared with 77,700 of September, 1956. *Glass Products Made of Purchased Glass*: The preliminary figure of 15,900 indicates an increase of 3.2 per cent from the previous month's figure of 15,400.

Payrolls in the glass industry during October, 1956 were as follows: *Flat Glass*: An increase of 1.9 per cent is shown in the preliminary $15,101,849, when compared with September, 1956 adjusted $14,817,355. *Glass and Glassware, Pressed and Blown*: An increase of 21 per cent is shown in the preliminary $30,879,888 reported for October, 1956 when compared with the previous month's adjusted $25,494,924. *Glass Products Made of Purchased Glass*: A preliminary figure of $4,879,551 was reported for October, 1956. This is an increase of 6 per cent compared with the adjusted figure of $4,605,986 of the previous month.

GLASS CONTAINER SHIPMENTS
(All Figures in Gross)

Narrow Neck Containers

	Nov. 1956
Food	853,000
Medicinal and Health Supplies	1,140,000
Chemical, Household and Industrial	666,000
Toiletries and Cosmetics	697,000
Beverage, Returnable	457,000
Beverage, Non-returnable	53,000
Beer, Returnable	72,000
Beer, Non-returnable	456,000
Liquor	1,073,000
Wine	457,000
Sub-total (Narrow)	5,924,000

Wide Mouth Containers

Food	*2,991,000
Medicinal and Health Supplies	425,000
Chemical, Household and Industrial	159,000
Toiletries and Cosmetics	207,000
Packers' Tumblers	92,000
Dairy Products	211,000
Sub-total (Wide)	4,085,000
Total Domestic	10,009,000
Export Shipments	255,000
TOTAL SHIPMENTS	10,264,000

*This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All Figures in Gross)

		Production Nov., 1956	Stocks Nov., 1956
Food: Medicinal and Health Supplies; Chemical, Household and Industrial; Toiletries and Cosmetics	Narrow Neck	4,050,000	4,805,000
	Wide Mouth	*4,304,000	*4,299,000
Beverage, Returnable		609,000	1,198,000
Beverage, Non-returnable		69,000	171,000
Beer, Returnable		147,000	272,000
Beer, Non-returnable		554,000	565,000
Liquor		1,314,000	1,169,000
Wine		537,000	502,000
Packers' Tumblers		107,000	142,000
Dairy Products		243,000	261,000
TOTAL		11,934,000	13,384,000

*This figure includes Fruit Jars and Jelly Glasses.

Glass Container Production, based on figures released by the Bureau of Census was 11,934,000 gross during November, 1956. This represents a decrease of 11.2 per cent from the previous month's production of 13,435,000 gross. During November, 1955, glass container production was 10,557,000 gross or 11.6 per cent under the November, 1956 figure. At the end of the first eleven months of 1956, glass container manufacturers have produced a total of 132,373,000 gross. This is 5 per cent over the 126,095,000 gross produced during the corresponding 1955 period.

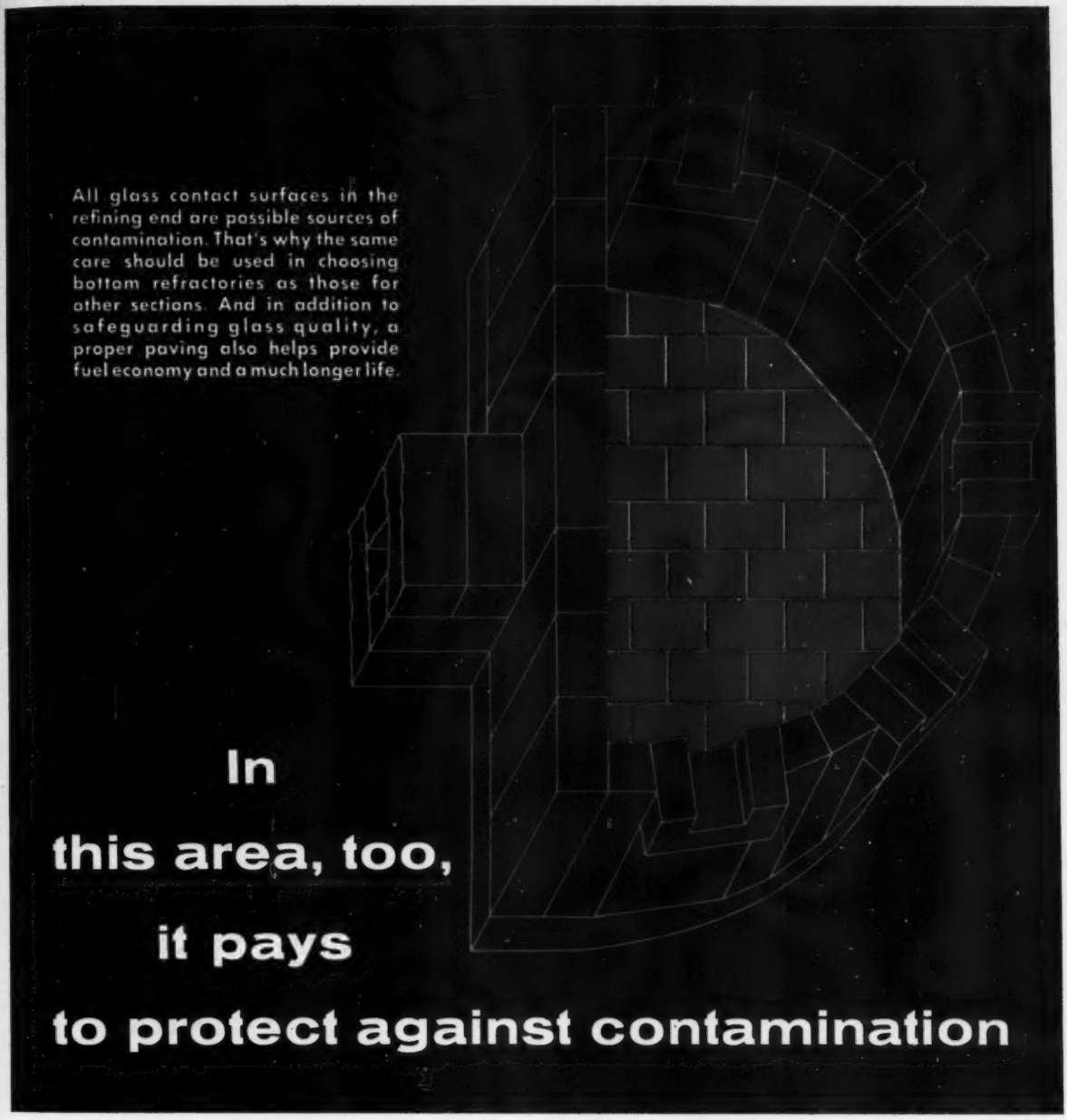
Shipments of glass containers during November, 1956 decreased 31 per cent to drop to 10,264,000 gross. This is a decrease from October, 1956 shipments which were 14,830,000 gross. Shipments during November, 1955 were 10,117,000 gross or 1.5 per cent under November, 1956. At the end of the first eleven months of 1956, shipments have reached a total of 130,688,000 gross, which is 5.7 per cent over the 123,640,000 gross shipped during the corresponding period last year.

Stocks on hand at the end of November, 1956 were 13,384,000 gross. This is 14 per cent above the 11,741,000 gross on hand at the end of October, 1956 and 5.3 per cent lower than the 14,123,000 gross on hand at the end of November, 1955.

Automatic Tumbler Production during October, 1956 was 3,909,000 dozen. This is a loss of 32.8 per cent against the October, 1955 production, which was 5,819,000 dozen.

Shipments during October, 1956 rose to reach 5,031,000 dozen. This is 21.9 per cent lower than the 6,443,000 dozen shipped during October, 1955. At the end of the twelve months period ending October 31, 1956, shipments have reached a total of 55,075,000 dozen which is 11.2 per cent lower than the 61,987,00 dozen shipped last year.

Table, Kitchen and Household Glassware: Manufacturers' sales of machine-made table, kitchen and household glassware during October, 1956 reached 4,203,000 dozen. At the end of the twelve month period ending October 31, 1956 manufacturers had sold a total of 32,913,000 dozen, which was 12.9 per cent lower than the 37,785,000 dozen sold during the corresponding 1955 period.


All glass contact surfaces in the refining end are possible sources of contamination. That's why the same care should be used in choosing bottom refractories as those for other sections. And in addition to safeguarding glass quality, a proper paving also helps provide fuel economy and a much longer life.
In
this area, too,
it pays
to protect against contamination

The dense, tightly-locked crystalline structure of MONOFRAX® M fused cast refractories gives such effective resistance to the corrosive action of most glasses that it makes a semi-permanent paving for refining end bottoms.

The extreme purity of MONOFRAX M refractories plus the practically complete absence of a glassy phase tend to help reduce seeds, stones, and cords. These refractories consist of over 98% alumina with less than 0.2% impurities. They give a tight-fitting, more durable paving because the blocks are carefully made to closer tolerances. Depending upon construction, fuel savings are effected.

Look into MONOFRAX refractories to lengthen the life of any area of your tank—and to improve glass quality. For information write:

CARBORUNDUM
Registered Trade Mark
Dept. L17, Refractories Division, Perth Amboy, N. J.

the trend is to MONOFRAX® **FUSED CAST** *refractories*

Safety Planning . . .
(*Continued from page* 36)

The long fight against lacerations from broken glass is paying off in handsome dividends spelling fewer injuries for workers in Pittsburgh Plate Glass Company's glass manufacturing plants. Much of the credit goes to the Safety Department which has developed the new safety equipment John Smith, cut-off man, is wearing. It consists of new sleeves, safety apron, leggings and improved shoe protectors.

Shown above is a "scoreboard" type of safety exhibit which immediately informs employees of the safety status at Pittsburgh Plate's Works #1 at Creighton, Pa. It also helps to remind them as the slogan depicts, "Safety is always in season."

of its body protective equipment, which it has especially designed, to cope wtih the exposures encountered in the handling of glass and other hazardous operations.

In our paint and chemical divisions we deal with organic and inorganic compounds and exposures to solvents, insecticides, lead and numerous other toxic materials, requiring the use of body protective and special respiratory equipment. Our mining operations include coal, limestone and silica sand mines and an outstanding contribution to safety in mining has been made by some of these organizations.

We are constantly striving to achieve the utmost in protective clothing and equipment, and also to make work places at Pittsburgh Plate better and safer for our men and women. We believe that our company-wide safety program has achieved much progress in our continuing crusade to maintain safety and welfare of personnel throughout our widespread diversified operations.

How successful this program has been may best be cited by going back about 37 years to the period shortly before our accelerated safety program. In 1919, with ten operations covering 16,000,000 man-hours, our rate for disabling accidents was 60.00 per million man-hours worked. As previously mentioned, our 45 stateside operations totaling 49,947,726 man-hours worked, established a record frequency rate of 5.3 disabling accidents per million man-hours. It also is interesting to note that both last year's frequency rate and severity rate of 477 were lower than the National Safety Council's frequency and severity rates of 6.96 and 815, respectively, for industry as a whole.

Such significant progress is the result of hard work and continual vigilance down through the years by everyone at Pittsburgh Plate. While our advances in safety have been notable, we, nevertheless, are continually endeavoring to improve on our progress. We hope we can achieve the plant environment, which, while emphasizing individual responsibility exercised at all times and at all levels, will provide a greater freedom from accident and fire in the years ahead.

D. B. ADAMS NAMED MANAGER

D. B. Adams has been named manager of the Owens-Illinois Glass Co. glass container manufacturing plant at Clarion, Pa.

He succeeds Harold Ottesen whose new assignment will be announced in the near future, according to Miles G. Beishline, vice president and general factories manager of the Glass Container Division.

Mr. Adams, who has been chief industrial engineer for the Glass Container Division since 1952, will be succeeded by Oliver F. Runde, the division's assistant chief industrial engineer.

Mr. Adams, served three years on the clerical and industrial engineering staffs of the O-I plant in Columbus before he was assigned to the industrial engineering department.

Mr. Runde, joined Owens-Illinois as an industrial engineer at the Charleston, W. Va., plant in 1937. He became plant supervising industrial engineer at Columbus in 1939, and in 1947 was made supervising industrial engineer of a mechanization program.

Viking Glass Company replaces one Laclede-Christy melting pot with another. For good reason—Laclede-Christy pot was used 664 days before replacement.

664 days production from one melting pot

A record? It certainly was. But this 664-day melting pot performance at Viking Glass Company is typical of the advantages obtained from Laclede-Christy refractories. It also explains why Laclede's glass industry customers come back for more.

Why? One reason is Laclede's quality control—maintaining exact ingredients and product uniformity. Another is Laclede's constant research for new materials and methods to produce longer-lasting, more efficient refractories.

Long refractory life, low operating costs and service to customers is Laclede's way of earning your glass refractory business. Next time call *Laclede-Christy Division, H. K. Porter Company, Inc., 2000 Hampton Avenue, St. Louis 10, Missouri.*

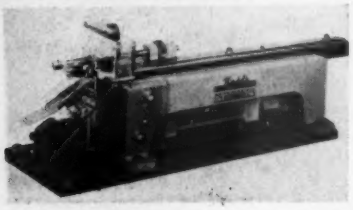
HKP LACLEDE-CHRISTY DIVISION

H. K. PORTER COMPANY, INC.

Divisions of H. K. Porter Company, Inc. are: Alloy Metal Wire, Connors Steel, Delta-Star Electric, Henry Disston, Laclede-Christy, Leschen Wire Rope, McLain Fire Brick, Quaker Pioneer Rubber, Quaker Rubber, Riverside Metal, Vulcan Crucible Steel, W-S Fittings.

New Equipment and Supplies

NEW STRIP CUTTER



Kahle Engineering Company, 1400 Seventh Street, North Bergen, New Jersey is now marketing a series of new grid strip cutter (chopper) machines. These machines are companion units to Kahle's high speed grid lathe which produces continuous grid strips of various lengths. Typical of these new strip cutters is Machine #2823 which accurately cuts wound strips into individual radio tube grids of all sizes. These sizes are controlled by special steel cutting blades and a unique "stop strip" holder which assures accuracy. To facilitate sharpening, these cutting blades are easily removed.
cutting blades are easily removed.

Designed for safety, Kahle grid strip cutters have full, protective guards that help prevent possible accidents. An air operated mechanism is used in this equipment to assure positive, dependable operation with minimum maintenance. Standard machines handle a variety of materials and material sizes—"customized" units for every production requirement can be supplied with a selection of features including full automatic programming.

Further information regarding the above may be obtained from Mr. Eli Stiefel at the company.

NEW HOT-PLATE/MAGNETIC STIRRER COMBINATION

Fisher Scientific Company, 498 Fisher Building, Pittsburgh 19, Pennsylvania has developed a double-duty apparatus —a 700-watt heater and magnetic stirrer combination. Designed to cut hours from routine stirring, mixing and dissolving operations, the "Thermix" has an insulated stirrer motor, insulating the stirrer motor from the ceramic-supported hot plate with an effective air-aluminum-asbestos-aluminum air heat barrier, thus preventing the combination stirrer and hot-plate temperatures reaching the danger point when near the heater. A Fiberglas extension keeps heat from traveling along the motor shaft. To conquer magnetic interference and corrosion, Fisher uses copper-jacketed heating elements cast directly into the aluminum top plate, resulting in a cool motor operation and a corrosion-resistant stainless-steel case that never gets hotter than 120°F. The hot-plate and stirrer can operate independently or simultaneously.

AIR GAGE SPINDLES

Air Gage Division, Dearborn Gage Co., Dearborn, Michigan has announced stock delivery of air gage spindles for any standard air gage instrument, regardless of make or model. The spindles are available in steel, chromium and carbide, in through-hole, counterbore and blind types, and in sizes ranging from 0.275 to 3 inches in diameter.

The offering marks an important step in the trend toward standardization and interchangeability of air gage elements and accessories.

CATALOGS RECEIVED

Bailey Meter Company, 1050 Ivanhoe Road, Cleveland 10, Ohio, have published a 16-page Product Specification G71-7 booklet. This booklet illustrates and describes instrument and control panels and their accessory equipment to meet the individual specifications from six standard designs.

Askania Regulator Company, 240 East Ontario Street, Chicago 11, Illinois, have issued a new bulletin 301, "The Askania Transometer". This six-page bulletin describes the applications for and the features of the transometer which comprises a positive displacement type flow meter and a pneumatic signal transmitter. The bulletin diagrammatically illustrates how the device is used for flow, ratio and combustion control; for multiple fuel totalization and for interchangeable control in fuel switch over. The bulletin lists ranges, specifications and performance features.

Cratex Manufacturing Company, 81 Natoma Street, San Francisco 5, Calif. manufacturers of rubberized abrasives, has just issued an Application Case History which gives an improved method for final polishing in the manufacture of glass molds and general maintenance of the same which are used on hydraulic molding machines.

Automatic Temperature Control Co., Inc., 5200 Pulaski Avenue, Philadelphia 44, Pa. have recently released the second edition of the company's general catalog. Presented in the catalog D-31, is a complete picture of the products and services offered by ATC for the field of Automation. Some of the products covered are differential transducer control and automation systems, a complete line of time control equipment, etc. Requests should be addressed to the advertising manager at the company.

Pangborn Corporation, Hagerstown, Maryland has just issued a new 12-page illustrated manual on the full spectrum of blast cleaning abrasives, their characteristics, application and selection. The work details methods for improving cleaning quality and cutting production costs in foundry, descaling, mold and die, shop maintenance, decorating and carving, part reclamation and finishing operations. This guide describes the importance of selecting the proper type and size of abrasive, covers abrasive properties and outlines the importance of selecting the correct abrasive for new blast cleaning equipment. The characteristics of Pangborn abrasives including Tri-Steel Shot, Malleabrasive Shot and Grit, etc. are given. Specifications of soft abrasives such as sawdust, walnut shells, pecan shells and rice hulls are also reviewed. Copies of this manual No. 333 may be obtained from the company.

General Electric Company, Schenectady 5, New York has issued Bulletin GEA-6133A. This 8-page bulletin, on Gear Motors, illustrates product features and includes gear motor selection data, dimensions, ratings and specifications of General Electric fractional horsepower gear motors. General Electric Company also issued bulletin GEA-6578 "Fundamentals and Features of General-Purpose Static Control Logic Elements." This 8-page bulletin defines Static Control, lists advantages, and describes components of GE's general-purpose Static Control system. It explains how Static Control operates without moving parts and covers the logic function concept, logic functions and conventional control, basic principles, circuit characteristics monitor lights and amplifiers.

Selas Corporation of America, Dresher, Pa. has recently published a revision of their latest bulletin SC-1006, "Selas Combustion Safeguards." This bulletin describes the operation and construction of Selas Automatic Fire Checks, which detect, localize and extinguish flashback in mixture supply line, where a combustible mixture of fuel gas and air is distributed to heating equipment, and Selas Safety Blow-outs which prevent flashback.

TENTH ANNUAL SERVICE AWARDS BANQUET HELD BY OVERMYER

Ralph Edgar

Overmyer Mould's long service employees were recognized recently at the company's Tenth Annual Service Awards Banquet on November 19, 1956. There were 135 OMCO employees present to witness award presentations to 69 fellow workers.

The master of ceremonies for the evening was OMCO's vice president, E. R. Flatter. Following dinner, Mr. Flatter introduced the guests of honor.

The principal speaker of the evening was Ralph Edgar, vice president and labor relations director for Ball Brothers Company, Muncie, Indiana. Mr. Edgar gave a brief extemporaneous talk to fit the occasion. He spoke of the importance of the glass industry to our national economy and of the industry's need for the skilled craftsmen trained by the Overmyer Mould Company.

Mr. Edgar observed that a similarity existed in the function of a glass mold to the character development of the individual. The relationship was illustrated by pointing out that the mold forms a shapeless and useless gob of glass into a useful thing of beauty and utility. In comparison to this mechanical development, he stated that each of us come into the world in a quite helpless form, but as we mature, our lives and character are molded into a form which enables each man to contribute to society. In each case, the shapeless gob of glass and our lives are molded in forms which serve useful purposes in our society.

Mr. Edgar further emphasized the progress of labor-management relations throughout the years and he concluded that in spite of the "soap box antics" of certain individuals, the relationship is a sound and healthy one. It is the progress of labor-management relations which has enabled the American worker to achieve the highest standard of living ever enjoyed by the workers of any country.

Mr. Edgar concluded his remarks by stressing the importance of the proper attitude and spirit of teamwork.

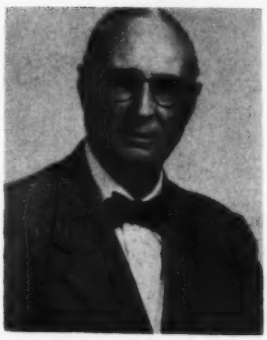
The first awards of the evening were beautifully engraved Hamilton wrist watches to eight OMCO employees who completed their 25th year of service during 1956. Awards were presented by OMCO's president, Lowell Roesner. Mr. Roesner acknowledged the importance of the stability of the long service workers which has seemed to permeate the organization. This stability has been a factor in the success of the company.

Lapel pin awards were given to other employees with from ten to thirty years of service. Each received a lapel pin inscribed with the numeral for the five year interval completed. Charles Manrose, secretary and treasurer presented the thirty year lapel pin awards, Max Hawkins, sales manager the twenty year service pins, Vernon Ruble Mould Division superintendent presented the 15 year lapel pin awards, and Max Hawkins the 10 year awards.

Following the service awards, Mr. Flatter awarded certificates to nine skilled workers who completed a four-year apprenticeship program during 1956. Special recognition was also extended to OMCO's growing list of retired workers.

The program contained a memoriam to C. P. Overmyer, Sr., Donald P. Strahan and Kenneth Wood, deceased members of the OMCO Twenty-Five Year Club.

FRANCIS C. FLINT NAMED 1957 BLEININGER MEDALIST



Francis C. Flint, technical director of the Hazel-Atlas Glass Division of the Continental Can Company, has been chosen to receive the 1957 Albert Victor Bleininger Award. Presentation of the medal and scroll, symbolizing the award, will be made at the Tenth Annual Award Dinner to be held March 15, 1957 in the Terrace Room of the Penn-Sheraton Hotel, Pittsburgh, Pa. The Bleininger Award, one of the highest honors for achievement in ceramics, has been given each year since 1948 by the Pittsburgh Section of the American Ceramic Society.

A distinguished glass technologist, Mr. Flint is one of the most active members of the Glass Division of the American Ceramic Society. He is the author of numerous technical papers and patents on glass. The first Gordon Conference in the field of glass was organized and presented under his chairmanship.

Born November 29, 1890 in Chicago, Mr. Flint received his high schooling at Long Beach, California, and his B.S. degree from Pomona College at Claremont, California in 1915. After a year of graduate work at the University of California he returned to Pomona College as a chemistry instructor and two years later accepted a position as chemist with the E. I. duPont de Nemours & Co., Inc. He began his association with Hazel-Atlas in 1919 as technical director and still holds the position.

Mr. Flint joined the American Ceramic Society in 1919 and served as president in 1936. He was American treasurer of the Society of Glass Technology (British) from 1926 to 1953. Among the honors bestowed upon Mr. Flint are his selection as Fellow of the American Ceramic Society, Honor Fellow of the Society of Glass Technology, and recipient of the first Toledo Glass and Ceramic Award which was established in 1956. He is also a member of the American Chemical Society and the American Institute of Chemical Engineers.

The Glass Industry—1956

(*Continued from page* 24)

Sight Glasses

Sight glasses which require neither solder nor gaskets, thus eliminating the main sight glass failure points, are now being made. A new manufacturing process makes possible a long-wearing unit in which the glass is hermetically sealed directly to metal.

Pressure resistance of the windows is dependent on the size and shape of the individual unit. One design ⅜ inch in diameter and ⅛ inch in thickness withstands pressures in excess of 5,000 psi. Another assembly ¾ inches in diameter and ⅛ inch thick operates at 2,000 psi. The windows showed no leaks when tested on a helium lead detector at maximum sensitivity.

Shielding Window

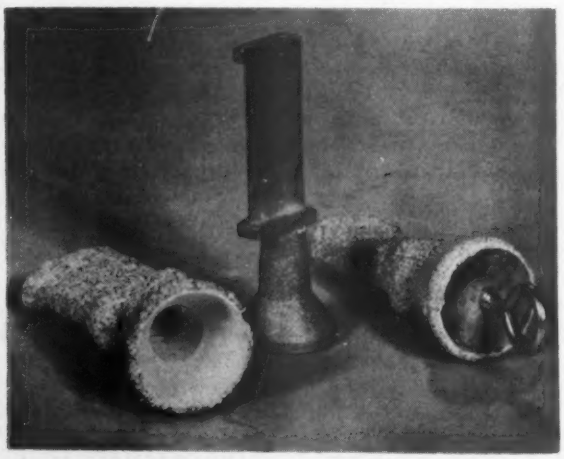
A three-foot thick radiation shielding window weighing three tons has recently been shown. The window measures 30 x 36 inches on the hot side and 18 x 30 on the cold side, has a density of 3.3. and offers shielding equivalent to three feet of barite or magnetic concrete. The non-browning lead glass forming the window has an index of refraction of 1.594, enabling the viewer on the cold side to "look around corners" on the hot side.

Radiation shielding windows are now available up to five feet thick, weighing 34,000 pounds with a viewing area of 7,000 square inches on the hot side, and completely ready for installation.

Metal Casting Technique

A new low-cost precision metal casting technique utilizing one-piece glass powder molds has recently been announced. The new casting method. known as the Glascast disposable pattern process, follows the lost wax investment casting technique in certain aspects. However, it eliminates entirely the need for investment material and containers, dewaxing ovens, power equipment to move investments, and all knockout equipment.

The lightweight Glascast molds are made by dipping a wax pattern into a Glascast slurry, coating it with coarser Glascast grains and, after drying the assembly, dipping and coating it several times, building up the mold shell. The assembly is then fired (with the wax pattern being removed at the same time), and the mold is ready for casting without further treatment.



The casting (center) from Glascast mold has high surface finish and close dimensional control. Mold assembly is seen before firing and dewaxing (right) and after firing (left).

The process was developed for casting close tolerance precision parts of high temperature alloys. The one-piece molds, capable of withstanding extremely high heats and sudden temperature changes, yield blemish-free castings with surface finishes of 20 to 40 microinches.

Tight dimensional control of fine definition castings is assured by the extremely low thermal expansion of the mold material, a 96 per cent silica glass powder. Low dimensional change and absence of firing shrinkage in the molds enable accurate calculation of metal expansion. The molds can readily withstand metal pouring temperatures up to 3300 F. with tolerances of ±.005 per inch.

The thin Glascast mold shell (⅛ to ¼ inch thick) assures extremely rapid cooling to control grain sizing. Metal contraction after casting causes the non-contracting Glascast mold to crack off, freeing the casting of adhering ceramic material and eliminating knockout equipment and time.

The Glascast mold has excellent resistance to thermal shock. Metal alloys with high melting points may be poured into a cold mold without fear of its cracking, although preheating is recommended. Coefficient of expansion for the material is .00000047 inch per inch per degree F. between 0° and 587° F.

Components of Heat-Resistant Glass

Two special components of heat-resistant glass are key units of the all-glass oven featured in the General Motors "Kitchen of Tomorrow." A transparent dome of boro-silicate glass covers the counter-top oven and a disk of extreme heat-resistant Vycor brand glass forms the unit's burner plate. The Frigidaire division of General Motors exhibited the oven at the 1956 Motorama. Vycor brand glass, which can withstand temperatures as great as 1650 degrees F., was selected for the burner plate of the oven.

Designed to permit baking, broiling, or barbecuing with the food in full view, the oven unit cover consists of two Pyrex brand glass hemispheres, one mounted inside the other. The larger dome, 28 inches in diameter, is one of the largest pieces of glass ever blown. The smaller dome is 26 inches in diameter.

The two domes were sealed to a single ring gasket at General Motors and mounted over the heating unit. An envelope of cool air between the two domes keeps the outside glass cool, even when temperatures on the inside reach up to 500 degrees F. A flick of a button sends the domes swinging under the unit to disappear completely, allowing unhindered access to the oven.

The burner plate, 19 inches in diameter, is the largest single piece of Vycor ever made. The ¼-inch plate was manufactured in two halves, then fused together at extremely high temperatures and fritted on the bottom to cut down glare from the heating units. These units consist of four lamps, generating heat up to 1000 degrees F. which were placed barely one-quarter of an inch below the Vycor plate.

Important Use for Glass Tubing

Borosilicate glass tubing turns up in unusual—and vital—places. For example, the Sylvania Strobeacon recently celebrated its 10th anniversary in the centerline approaching lighting installation at Newark Airport. This tiny lamp (it stands about 2¼ inches high) gives an ultra-brilliant beam of over 200,000,000 peak lumens from its high intensity flash tube made of glass tubing.

Ten years ago 23 of these lamps were installed along a single 2,400 foot lane in the runway approach path at Newark Airport. Since that time it is estimated that approximately 40,000 flights have been guided to safe landings at Newark by the system.

The light produced by one of these units is approximately five times greater than that of the most powerful lighthouse in use today, and the units, flashing in sequence toward the runway to give the effect of an animated arrow, can effectively pierce fog, mist, and smoke. Several of the larger airports in the country use this approach lighting system, although its use is limited by the amount of pre-runway space available to an airport.

Glass in Nuclear Energy Research

Corning Glass will soon begin to use a nuclear reactor in its research program. A new company, Industrial Reactor Laboratories, Inc., composed of 10 leading American corporations, will build and operate a privately owned nuclear reactor at Plainsboro, New Jersey, for industrial research in atomic energy. The reactor will be used to speed the development of stronger, more durable glasses and to investigate new uses for glass in the atomic age.

A company official has stated, "With neutrons and gamma radiation available as a major research tool, scientists will probe still deeper into the structure of glass as they attempt to extend the range of present compositions." The new glasses may have properties unmatched by conventional engineering materials.

Current research projects are being concentrated on the search for new materials which will have exceptional strength combined with unusual resistance to corrosion and heat shock. Potential application for these new glasses is predicted in such widely diverse fields as nuclear and solar energy, electronics and food processing, transportation, and chemical manufacture.

The 10 companies participating cooperatively in Industrial Reactor Laboratories, Inc., are American Tobacco Co., AMF Atomics, Inc. (subsidiary of American Machine & Foundry Co.), Atlas Powder Co., Continental Can Co., Corning Glass Works, National Distillers Products Corp., National Lead Co., Radio Corporation of America, Socony-Mobil Oil Co., and United States Rubber Co.

FUTURE PRODUCTS

The most challenging of tomorrow's products, according to David G. Hill, president, Pittsburgh Plate Glass Company, is the *variable transmission window,* a window whose opacity to light and radiant heat can be adjusted either manually or automatically to be just what the user desires. This product will have many applications in allowing builders and users to maintain style and an expansive feeling in buildings while at the same time avoiding the undesirable features of too much heat and too much variation in light intensity.

Electroluminescent panels for lighting the interiors of homes and offices are already being developed in the laboratories. These panels give off a low intensity of light when an electric field is applied to them and represent an extension of the mercury light concept to a broader application; a mercury light has a much lower intensity than an incandescent lamp but the increase area from which light is emitted results in a higher light value for the area to be illuminated. The most practical base on which to apply these electroluminescent coatings is glass. In the future, glass will serve not only as a decorative and durable surface for walls and ceilings but will also provide a base for coatings which will produce soft light for room illumination.

Glass covered with electrically conductive coats has been used successfuly as a source of heat. In the future, electrical energy will generally become lower in comparative cost and this method for controlled heating of buildings increasingly common. Then coated glass will be the most practical form for supplying long-lasting heating elements of life, completely enclosing and decorating the rooms without the possibility of the occupants' being burned by accidental contact with hot heaters.

The conservation of energy is an increasingly important problem. The fossil fuels, such as coal, may be partially replaced in the future as a source of energy by nuclear fuels, but even these have finite limits. Increasingly, thinking men are returning to and emphasizing the sun as our principal source of available energy. In the field of solar heat, glass will play a most important part. Glass will be used as a filter to allow the entrance of radiant heat into enclosures where it is absorbed and also as a barrier to prevent the escape of heat by convection and conduction once it has been captured. There are already examples of the use of glass for this purpose in some of the sunnier climates to heat homes and water for domestic use.

There are certain applications where the temperature reached by direct sunlight is not sufficiently high. Under these circumstances it is desirable to increase the temperature by collecting the sun's rays over a large area and then concentrating the energy into a smaller area. Reflecting mirrors used for this collecting of the sun's rays will grow in importance, and most of them will be made from glass. In the not-too-distant future such collectors will be able to furnish considerable quantities of power competitively in some parts of the world. In the more distant future, following the inevitable degradation of other power sources, enormous glass collectors will furnish very significant amounts of energy throughout the habitable world. Here could be one of the most extensive new mirror markets in many years.

Unbreakable glass will result from the extensive basic research being conducted today into the structure of glass and the extension of its properties by new compositions. This product has long been talked about, but it has only been recently that some of the puzzling mysteries surrounding the very old art of glassmaking have been solved. An unbreakable glass of this nature could be put into direct competition with metals in many areas where competition is now impractical and would open

new sales opportunities for jobbers. Machinability is a characteristic not normally associated with today's glass, even though sand blasting and ultrasonic methods can be used to fabricate glass today at a cost that is satisfactory for very special purposes. However, unbreakable glass would probably be machinable to an extent approaching that of metals.

An example of the expanded use of glass in architecture. The Philadelphia International Airport.

GLASS CONTAINER INDUSTRY APPLAUDED BY LABOR UNION

The Glass Container Manufacturers Institute received a hefty pat on the back recently from the Glass Bottle Blowers Association, via a full-page ad in "Bottling Industry," trade paper for the soft drink industry.

Congratulating the glass container industry on its nationwide advertising and publicity campaign to promote the sale of glass-packed products, the Union headlined its plaudit with: "Take A Bow, Glass Container Industry . . . Congratulations . . ." The GBBA happily acknowledges that the greater production of glass bottles, resulting from the increased demand which, in turn, was spurred by the GCMI campaign, has led to more stable working conditions and wider employment opportunities. The glass container industry is 100 per cent unionized, and employment in the 52,500 member union is at a record high. The ad also reproduces an editorial from "Bottling Industry" magazine titled "Labor Lends a Hand" which congratulates labor and management for working together to promote the industry.

GCMI ads, now entering the third year of the campaign, have appeared in leading women's service magazines and in 38 national and regional labor publications.

The GBBA, meanwhile, has been far from lethargic in also spreading the gospel of "Buy It In Glass." The Union is spending $60,000 this year for ads in labor publications, reaching an estimated 8 million union members.

• The appointment of Robert H. Johnson as Controller of the Pacific Coast Division L.O.F. Glass Fibers Company, was announced by John A. Morgan, Vice President and General Manager of the Division which headquarters at Burbank, California.

JULIAN P. STAPLES DIES

Julian P. Staples, executive vice president of the Pittsburgh Corning Corporation, died suddenly Sunday, December 9th at his home in Mt. Lebanon, Pa.

Mr. Staples, who had been general manager of the firm at its formation in 1937, was appointed Executive Vice President in 1950.

Born February 17, 1896 in Richmond, Virginia, Mr. Staples had spent practically his entire business career in the glass industry.

He joined the Macbeth-Evans Glass Company in 1921 and remained with them until 1937 when be resigned his post of Assistant Sales Manager to join the Pittsburgh Corning Corporation.

Mr. Staples was a graduate of Carnegie Institute of Technology, class of 1916, and a combat pilot in World War I. He resided at 30 Glen Ridge Drive, Mt. Lebanon, Pa. at the time of his death, and was a member of the Oakmont Country Club, Mt. Lebanon United Presbyterian Church and F&AM.

Mr. Staples is survived by his widow, Marjorie Mitchell Staples.

WALSH HOLDS SALES CONFERENCE

To acquaint personnel of the Walsh Refractories Corporation with recent improvements in the manufacture of Glass House Refractories, J. J. Duggan, vice president, rendered a complete progress report during a conference of Walsh Sales Representatives.

The three days Sales Conference was held at the Congress Hotel, in St. Louis.

BLUE RIDGE NAMES TWO OFFICERS

R. W. Smith **R. W. Rigg**

Two new vice presidents have been appointed by Blue Ridge Glass Corporation, Kingsport, Tennessee, president Joseph H. Lewis has announced. They are Raymond W. Smith, manufacturing, and Richard W. Rigg, marketing.

Mr. Smith has been with Blue Ridge since 1938, except for six years' active service in the U. S. Army during World War II.

A native of Massachusetts and a graduate of Massachusetts Institute of Technology, Smith came to Blue Ridge as assistant engineer, transferring to production in 1946.

Mr. Rigg has been associated with Blue Ridge since 1946 assuming complete charge of the sales department in 1954 when he came to Kingsport.

Inventions and Inventors . . .

(Continued from page 38)

device is operated is also dependent upon the composition of the glass and the amount of glass passed through the cylinder in a unit of time. When using crown glass at a pass-through rate of 100 pounds per hour, it was found that rotation of the blades at 28 to 45 r.p.m. gave excellent homogenizing results. On the other hand, using flint glass at a through-put rate of 40 to 45 pounds, about 40 r.p.m. also produced satisfactory results. These results will vary as the size of cylinder, stirring rate and glass composition changes.

There were 2 claims and the following references were cited in this patent: 1,631,061, Rankin, May 31, 1927; 1,792,059, Altwegg, Feb. 10, 1931; 2,569,459, De Voe, Oct. 2, 1951; 2,570,078, Spremulli, Oct. 2, 1951, and 2,626,786, McGlothlin, Jan. 27, 1953.

Glass Wool and Fiber

Treatment of Glass Fibers with Colloidal Silica. Patent No. 2,754,224. Filed January 31, 1952. Issued July 10, 1956. No. drawings. Assigned to Owens-Corning Fiberglas Corporation by Remus F. Caroselli.

This invention relates to the production of a new glass fiber product. The steps include heating of the glass fibers having first produced a layer of colloidal silica on their surfaces for at least 3 seconds to 50 hours. The time being varied proportionately with a temperature ranging from 50°F. below the fusion temperature for the particular glass composition to 400°F.

There were 21 claims and the following references were cited in this patent: Re. 19,372, Walton, Nov. 13, 1934; 2,215,150, Hannen, Sept. 17, 1940; 2,442,976, Heany, June 8, 1948; 2,505,629, Thomsen et al., Apr. 25, 1950; 2,513,268, Steinman, June 27, 1950; 2,526,684, Powers, Oct. 24, 1950; 2,577,936, Waggoner, Dec. 11, 1951; 2,593,817, Waggoner, Apr. 22, 1952; and 2,593,818, Waggoner, Apr. 22, 1952.

Coated Glass Fiber and Method of Making. Patent No. 2,754,223. Filed January 24, 1952. Issued July 10, 1956. No drawings. Assigned to Owens-Corning Fiberglas Co., by Remus F. Caroselli.

It is an object of this invention to produce glass fibers, yarns, cords and fabrics characterized by high abrasion resistance.

In the preparation of a 50 gallon batch of treating composition, 8 pounds of an anionic suspensoid containing 50 per cent by weight polytetrafluoroethylene in finely divided form is incorporated with stirring into about 25 gallons of water. 80 pounds of an anionic latex containing 40 per cent by weight butadieneacrylonitrile copolymer is introduced with agitation and then the mix is diluted with water up to 50 gallons. The composition contains about 1 per cent by weight polytetrafluoroethylene and about 7 per cent by weight butadieneacrylonitrile copolymer.

The composition is padded onto a glass fiber fabric after it leaves the oven. This process carries out the heat treatment step of the cited Waggoner et al. processes, wherein the glass fibers in fabric form, are heated at a temperature ranging from 1050° to 50° below the fusion temperature of the glass composition of which the fibers are formed. This continues from at least a few seconds at the higher temperature to a few minutes at the lower temperature, whereupon the size originally applied to the glass fiber surfaces is burned off at an early stage of the heat treating process. The glass fibers are thereby relaxed and weave set in their fabric form. Then the heat treated fabric is cured at a temperature of about 300° F. A composition containing about 1 per cent by weight stearato chromic chloride is padded onto the fabric which is again dried at about 300°F.

There were 16 claims and the following references cited in this patent: 2,471,959, Hunt, May 31, 1949; 2,531,134, Kropa, Nov. 21, 1950; 2,539,329, Sanders, Jan. 23, 1951; 2,552,910, Steinman, May 15, 1951; 2,604,427, Armstrong et al., July 27, 1952; 2,604,688, Slayter, July 29, 1952; 2,633,428, Klug, Mar. 31, 1953, and 490,877, Great Britain, Aug. 23, 1938.

Treating Glass Fibers with Colloidal Silica. Patent No. 2,754,221. Filed January 31, 1952. Issued July 10, 1956. No drawings. Assigned to Owens-Corning Fiberglas Co., by Remus F. Caroselli.

It has been found that the slippage and colorability of glass fibers may be markedly improved by the treatment which includes the application of finely-divided silica to the glass fiber surfaces, followed by a heat treatment.

A fabric woven of continuous-type glass fibers is submerged in an aqueous suspension containing about 15 per cent colloidal silica (SiO_2). The treated fabric, the fibers of which are substantially and completely coated with the silica composition, is dried and then it is subjected to heat treatment at a temperature of 1050-1250°F. for two to three seconds, but may be exposed for as long as thirty minutes. At this temperature range, the organic substances, usually applied as a size to the attenuated glass fibers, are almost immediately burned or distilled off. To prevent carbonization, which deposits discoloring substances that are thereafter difficult to remove from the glass fiber surfaces, it is desirable to carry out heat treatment under oxidizing conditions. Such conditions are indicated by burning-off with a bluish flame and it may be maintained by permitting free flow of air to the burning zone or by the injection of oxygen-enriched gases. At this temperature, it also appears that the moisture layer invariably present on the glass fiber surfaces, is subtantially eliminated.

A fabric prepared in accordance with this invention will be characterized by softness; draping and hand qualities of the finest silks; it will be wrinkle and crease resistant; it may be given a permanent color or design.

There were 11 claims and the following references cited in this patent: Re. 19,372, Walton, Nov. 13, 1934; 2,215,150, Hannen, Sept. 17, 1940; 2,526,684, Powers, Oct. 24, 1950; 2,577,936, Waggoner, Dec. 11, 1951; 2,593,817, Waggoner, Apr. 22, 1952.

• Promotion of Thomas M. Cox, Jr. to manager of administrative services in the Toledo general offices of Owens-Illinois Glass Co. has been announced by Palmer W. Hancock, vice president and comptroller. Mr. Cox has been succeeded as Manager of Office Methods and Procedures by Thomas H. Browning.

CALUMITE...

a two-way help to increased profits.

Directly and indirectly, Calumite is helping manufacturers of amber ware to increase their profits.

From the production viewpoint, Calumite insures greater glass stability, easier melting and increased production. Added values are found in diminished superstructure attack and stone loss, considerably reduced volatile attack and batch carry-out and longer checker life and furnace efficiency, all *directly* aiding in improving profits.

***Indirectly*, Calumite helps to increase profits by increasing the percentage of ware packed and through improved quality enhancing the saleability of your ware.**

Help yourself to increased profits now!

The Calumite Co.
HAMILTON, OHIO

Seventeenth Conference on Glass Problems . . .
(*Continued from page* 28)

master. Dr. Daniel Howland, Assistant Professor, Department of Industrial Engineering, Ohio State University, was the principal speaker. Dr. Howland spoke on the subject of "Operations Research in Industry." This most interesting subject was defined as research on operations and, of course, may be applied to an almost infinite variety of operations.

Operations research is usually carried out as a team project in which a number of individuals of varied skills and interests such as an engineer, mathematician, physicist, psychologist, nurse, and sociologist strive to solve effectively complex problems of industry or a community by contributions from each member of the team. It is thus the work of a team and the result of the efforts and contributions of many persons. Once all empirical and related data are obtained and assembled, models are made, usually on a mathematical basis. Once a working model is evolved, it may be imposed in various ways to attempt to solve the problem at hand. The model may be an implicit one such as a wind tunnel, road map, flow chart, etc., or it may be a personal one or merely an idea. Once a model is prepared, an estimate of performance or end use can be applied. The value of team effort is well recognized and becomes of considerable importance in proper use of the model.

Operations Research is not a cure-all or answer to all problems, but numerous interesting examples of its use were cited. One most interesting example was taken from World War II when the problem was solved of the orientation of radar in military service in England, especially as applied to early morning air raids. Other examples have been the proper scheduling of vehicles for large truckers, traffic control and orientation for air lines, and traffic control in large urban areas such as New York City. The Port Authority has adopted such techniques to ascertain the cause of delays, traffic jams, parking problems, etc. Hospital problems in Columbus, Ohio, receiving much study are those of examination, care of and operation upon patients, all of which study will provide ultimately more efficient hospital efficiency. This relatively new procedure and technique offers management an effective tool for solving many complex problems of industry as well as society.

Professors Blau, of Ohio State, and Tooley, of Illinois, are to be congratulated on furnishing another excellent program for the Seventeenth Glass Conference. The attendance was excellent, with the auditorium of the Historical and Archeological Museum at Ohio State University furnishing a most pleasing setting for the conference. Certainly everyone in attendance will look forward to the Eighteenth Glass Conference which is planned for the University of Illinois in December, 1957.

- Dr. Ronald C. Vickery, London-born scientist, and one of few world experts in the field of the "rare earths", has been appointed head of the Chemistry Department of Horizons Incorporated, Cleveland industrial and governmental research organization.

- Harold Boeschenstein, president, Owens-Corning Fiberglas Corporation, Toledo, Ohio was one of twelve members elected to the Board of Trustees of the Commitee for Economic Development.

Phase Separation in Sodium Phosphate Melts . . .
(*Continued from page* 31)

exist in molecular dimensions, then they should grow when proper nuclei are furnished. Present day electron microscopic techniques, capable of resolution to at least 20 Angstroms, should make it possible to detect a phase separation if it occurs.

Also, in the field of phase equilibria, as well as in studies of new systems leading to glass formation where platinum and its alloys are used as the container for the melts, it becomes important to know whether platinum is influencing the formation of either liquid or crystalline phases. The work of Forland[6] and co-workers has pointed out the existence of preferred groupings of ions in fused salts. It is quite possible that these groupings can be nucleated to grow on the same basis as in the sodium metaphosphate melts.

ACKNOWLEDGMENT

Sincere appreciation is expressed to Prof. Joseph Comer for making the electron microscope photographs, to Mr. Richard Vidanoff for preparing some of the melts and to the Glass Research Laboratory of the Pittsburgh Plate Glass Company for the support of the work.

To Professors W. A. Weyl, Tormod Forland and Evelyn C. Marboe, and to Mr. J. Krogh-Moe, the authors are indebted for valuable discussions concerning the work.

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(4) T. Forland, Personal Communication
(5) S. D. Stookey, "Photosensitive Opal Glass", U. S. 2,515,940, July 18, 1950
(6) (a). T. Forland, H. Storegraven and S. Urnes, "Beitrag zur Kenntnis der Struktur von Kryolith-Aluminum-oxyd-Schmelzen", Zeit Anorg. und Allgem. Chemie 279, 205-211 (1955)
(b). T. Forland, "Freezing Point Depression and Its Structural Interpretation" ONR Technical Report 63, N6 onr 269 T. O. 8, NR 032.264, College of Mineral Industries, The Pennsylvania State University (1955)

J. W. HERBERT NAMED SENIOR CERAMIC ENGINEER BY L-O-F

John W. Herbert, who joined the engineering department of Libbey-Owens-Ford Glass Company, a year ago, has been named senior ceramic engineer of the furnace design and improvement section, it was announced by William H. Hasselbach, vice president—engineering.

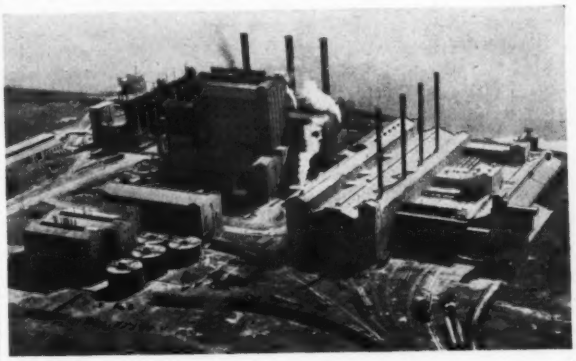
Before coming to Toledo he was a ceramic development engineer with the Erie Resistor Corp., Erie, Pa., and later product engineer with the Brush Electronics Co., Cleveland. He is a member of the American Ceramic Society and the National Institute of Ceramic Engineers.

In his new responsibilities at Libbey-Owens-Ford he succeeds Howard L. Miller, recently transferred to the Charleston, W. Va., plant as manager of the technical control department.

Milestones in Glass Progress

PHOTO COURTESY GLASS CONTAINER MANUFACTURERS INSTITUTE, INC.

1825 This distinctive flask, with its "sunburst" pattern in brilliant olive-amber, was produced about 1815-1850—probably at the Keene-Marlboro-Street Glassworks in Keene, N. H. It was blown in a full-size two-piece mold, and represents one of thirty known sunburst varieties popular at the time.



1890 Michigan Alkali Company, now a division of Wyandotte Chemicals Corporation (North Plant, above), was founded by Captain J. B. Ford to supply Soda Ash to the glass industry. Wyandotte has grown up with glass. Today, as in the past, it is a working partner, supplying technical assistance and raw-material chemicals to those great companies marking milestones in glass progress.

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Research Digest . . .

(*Continued from page* 39)

T = tensile strength.
K = constant representing strength due to cross-sectional area (lb./sq. in.).
L = constant representing surface effect (lb./in.).
D = diameter of specimen.

From the data obtained in these experiments values for K and L were found and after substituting in equation (2) the strengths contributed by cross-section area and by surface for the three types of glasses calculated.

As a result of these studies it was concluded that:

(1) When soaking time is kept constant at 24 hours, the strength of glass fibers increases with the temperature to a point where no further increase takes place. This point depends on the chemical durability of the glass. For a 24-hour soaking period the borosilicate glass did not reach its strength maximum even at 90°C., whereas the soda-lime and lead glasses reached their maximum strength for a similar soaking time at a temperature between 30° and 60°C.

(2) This behavior is in agreement with the flaw theory and with the results of Stockdale, Tooley, and Ying on the same glasses keeping the temperature constant at 90°C and varying the soaking time.

(3) The strength of glass may be considered as the summation of two factors: the area factor K and the surface factor L. In all treatments of the type studied, as it is the surface and not the interior that is mainly affected, the resulting strength change may be represented as the change in the surface factor alone. The L values and the change in L values are relatively independent of the size of the specimen except as strengths are affected by the manner of specimen preparation; hence, it is suggested that L values may be used to correlate the results on various sizes of specimen for similar treatments.

J. D. BIGGERS AWARDED ROYAL DECORATION

John D. Biggers, chairman of Libbey-Owens-Ford Glass Company and president of the Toledo Museum of Art, has been honored with the commander's cross of the Order of Orange Nassau by decree of Queen Juliana of the Netherlands.

The announcement and investiture was made on Nov. 1 by Baron S.G.M. van Voorst tot Voorst, minister plenipotentiary of the Netherlands Embassy, Washington, D.C., at Toledo for the opening of a special showing of "Dutch Art—1946 to 1956" in the Toledo Museum.

At the same time the Baron presented a knighthood in the same royal order to Otto Wittmann, associate director of the Museum.

Baron van Voorst said the award was made to Mr. Biggers by a royal decree signed on Aug. 9, 1956.

"This high distinction has been awarded as a token of the appreciation of Her Majesty and of the Netherlands Government for the outstanding merits of Mr. Biggers in promoting cultural relations between the United States and the Netherlands in his capacity as president of the Museum," declared Baron van Voorst.

• Frank A. Vickery has been named to the newly-created position of administrative sales manager of Hartford-Empire Company Division, Emhart Mfg. Company.

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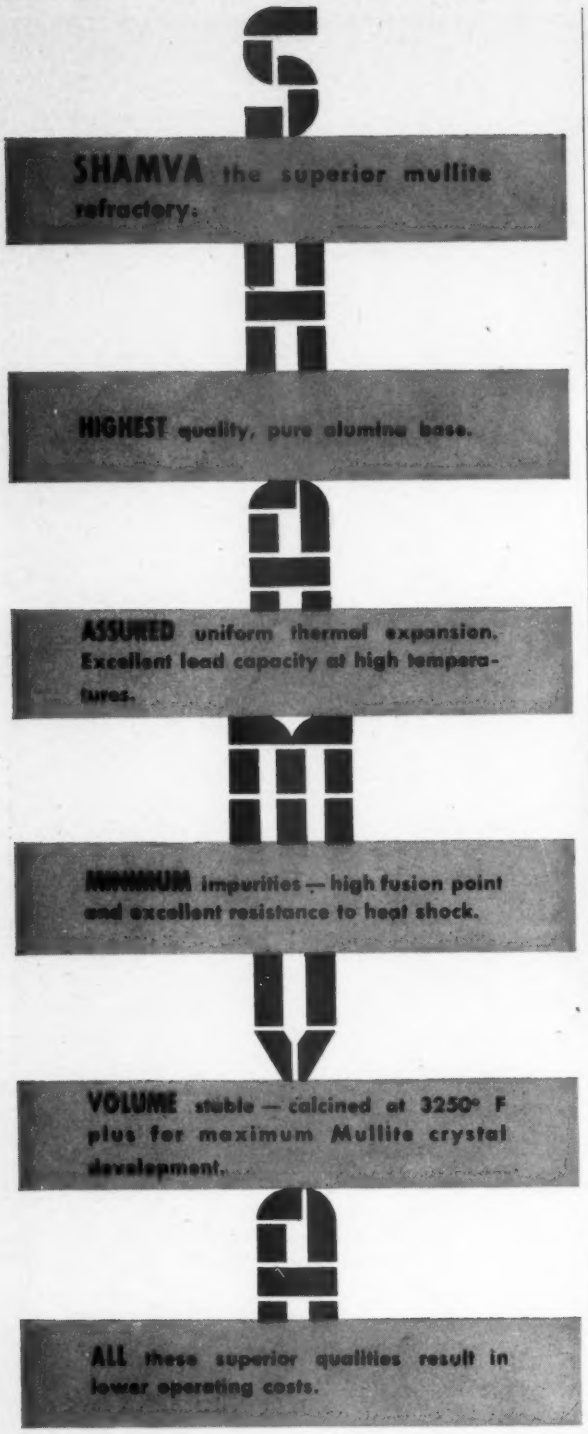
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DIAMOND ALKALI APPOINTS T. F. HOLDER

Appointment of Thornton F. Holder to the post of director of research for Diamond Alkali Company, Cleveland, Ohio, was announced by president John A. Sargent. The appointment is immediate.

Mr. Holder replaces Dr. Albert W. Meyer, who has resigned from his present position as director of exploratory research. Dr. Meyer plans to continue in the field of chemical research. He will announce his plans in the near future.

In addition to taking over direction of Diamond's exploratory research program, Holder will continue to be responsible for its patent and trade mark activities and supervision of general-purpose research facilities and operations otherwise unassigned. He will also continue to assist the president of the company in coordinating Diamond research efforts with the activities of its various operating divisions and other organizational units.

AMERICAN POTASH PROMOTES B. M. HOLT

Benjamin M. Holt has been appointed to the newly-created post of project director of the Planning and Development Department of American Potash & Chemical Corporation, according to an announcement by Daniel S. Dinsmoor, AP&CC vice president in charge of Planning and Development.

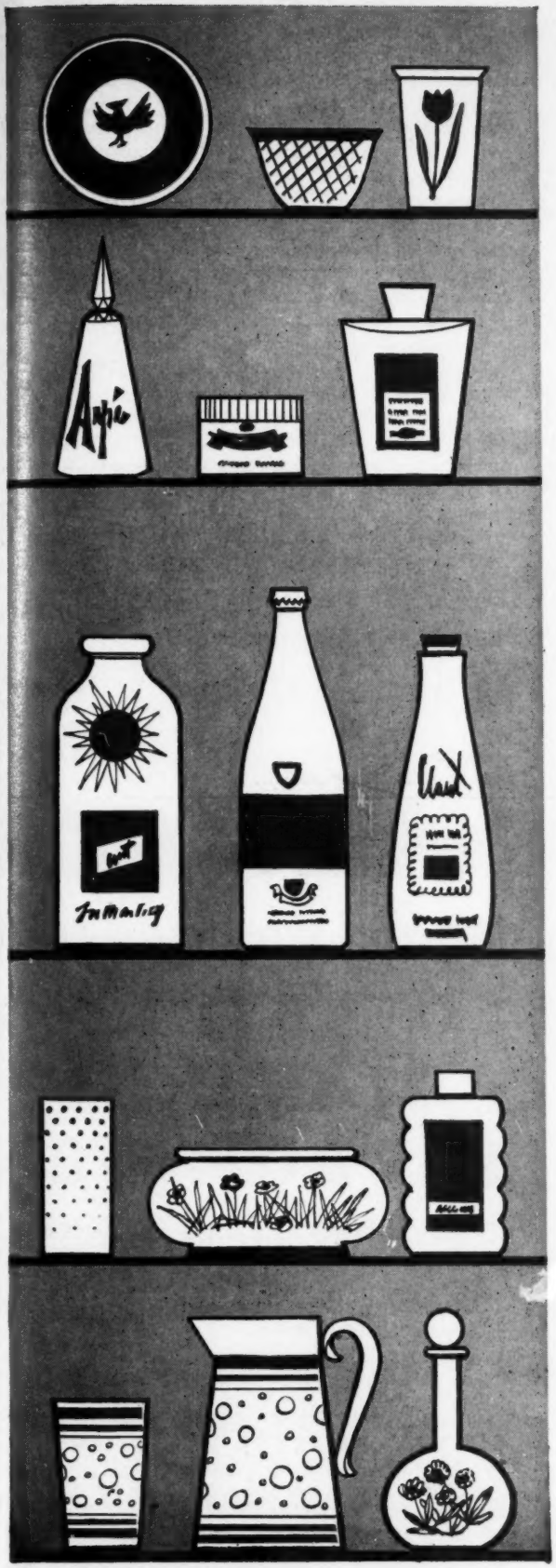
In his new position, Holt will be in charge of special major projects being developed operating under Dinsmoor's direction.

Holt formerly was with the Ralph M. Parsons Company prior to his recent joining of American Potash & Chemical Corporation.

BROCKWAY PROMOTES R. L. WARREN, JR.

G. A. Mengle, president of Brockway Glass Company, Inc., has announced that, effective November 1, 1956, the activities of the Purchasing Department will be under the direction of Robert L. Warren, Jr., a vice president of the company. This will be in addition to Warren's present duties.

• Thomas R. Robinson has been appointed to the General Plant Manager's staff of Brockway Glass Company, Inc. Mr. Robinson will aid in production, cost, and personnel problems directed toward increased production.



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BOOK REVIEW

Die Silicatischen Tonminerale

By K. Jasmund. 2nd Edition.

This is a second edition of a monograph on silicate minerals in clay, which made its first appearance in 1950. Since then many new articles have appeared on the subject, even up to the press time of this new edition. Because the data presented and the conclusions reached in the first edition have retained their essential validity, there was no need to rewrite the whole of that material, and to avoid making the monograph too bulky, it was necessary to keep the insertions of new information as brief as possible. References to the literature, formerly numbering 350, were increased to 530.

The first part of the book is devoted to a general survey of the subject and deals with the mineralogical composition of clays, the most important methods of investigation, the structural constitution and synthesis of some clay minerals, their characteristic properties, including selling, ion linkage and exchange, viscosity, plasticity and thixotropy. The second part gives details of the characteristics and properties of some twenty-two individual minerals, classified into groups, namely kaolinitic, dioctahedral and trioctahedral types of minerals belonging to the Montmorillon class, fibrous and micaceous structures. The book presents in concise form a vast amount of information concerning clay materials.

Die Silicatischen Tonminerale contains over 43 figures and 74 tables. It may be obtained (in German) from Verlag Chemie, GmbH. Weinheim/Bergstrasse, Germany. Price $4.20.

The Vitreous State

In April, 1953 a Symposium on "The Vitreous State" was held in the Department of Glass Technology of the University of Sheffield, when a number of prominent workers in the fields of inorganic solids and liquids, and colloids delivered lectures on their own fields of work, with special reference to the structure and constitution of vitreous materials. The interest aroused by the lectures led to the publication of this book, even though publication was unavoidably delayed by a variety of circumstances. This meant that in certain directions, existing knowledge had gone somewhat beyond the stage described in the papers; where possible, however, this has been indicated by notes at the proof stage.

The book covers such topics as: "X-ray and Other Micro Techniques and their Application to the Glassy State; Some Metallurgical Aspects of the Vitreous State; Atomic Packing in Silicate Glasses; A Summary of Recent Advances in the Study of the Structure of Liquid Silicates; Thermodynamic Aspects of Slags and Glasses; Homogeneous Nucleation in Supercooled Liquids; Structural Principles in Solid Inorganic Compounds; Structure in Colloids; and The Stability Relationships of Ionic Phases and their bearing on the Vitreous States."

This book is published by the Glass Delegacy of the University of Sheffield, 154 pages, price 25/-d.

• H. S. Saunders, director of the frit research laboratory of the O. Hommel Company, Pittsburgh, Pennsylvania, was recently named chairman of Sub-Committee IV on Raw Materials at a recent meeting of the American Society of Testing Materials.

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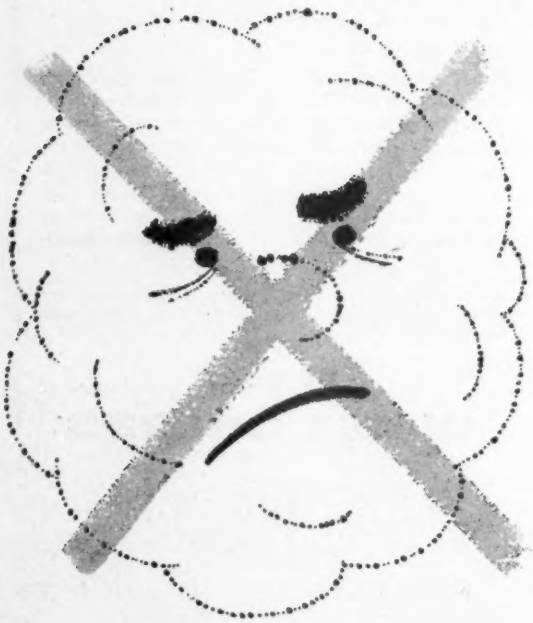

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BOOK REVIEW

Economic Geography of Industrial Materials

Edited by Albert S. Carlson

Written by top experts in a wide range of key industries, this fact-filled handbook answers many problems that industry must face in today's changing atmosphere.

Each chapter, packed with maps, tables, charts and statistics, describes economic-geographic conditions necessary for profitable production. Such factors as location, climate, soil, topography, water resources, minerals, fuels, labor, capital, management, transportation and markets are discussed and evaluated to show profitable trends and conditions at present and in the future. Each of these factors was carefully studied and appraised by the company, trade association or individual who wrote the particular chapter involved. The book is divided into five parts which cover such topics as resources and transportation, fuel and power for industry, products from minerals, natural and synthetic products, agricultural and food products. The Part III, for example, under Products from Minerals, lists a chapter on Glass by Samuel Ray Scholes of the New York State College of Ceramics, Alfred University, Alfred, New York.

Industrial management will find this book valuable as a means of studying its product, process and location attributes in the light of current and future economic conditions in its locality, in its country and in the world.

Published by Reinhold Publishing Corporation, 430 Park Ave., New York 22, N. Y.; 494 pages; price $12.50.

NEW RESEARCH LABORATORIES OF THORIUM LIMITED

G. H. Beeby, chairman of I.C.I. Salt Division and also of Thorium Limited, opened the expanded Research Laboratories of Thorium Limited at Ilford, Essex, November 14th. In his speech, Mr. Beeby said that the decision to expand the laboratories showed that the board of the firm realized the part which the research department had played in the company's development and were confident that it would play an increasing part in the future. Although there is no easy way to decide how much a firm should spend on research, he emphasized that he and his colleagues on the board were prepared to support the research department as much as possible. Only in this way, he said, could Thorium Limited meet the demands of the future which held considerable promise not only because of the potential use of thorium in atomic energy production but also because of the growing development of uses for the lanthanons (rare earth elements).

Thorium Limited specializes in the production of thorium and the lanthanons and in the manufacture of highgrade polishing powders based on the oxide of cerium (one of the lanthanons). The latter are sold under the trade name "Cerirouge". The research department manager is R. J. Callow. The work of the laboratories is directed principally to research into methods of production and purification of the firm's products, into methods for process control and into the production and properties of polishing powders.

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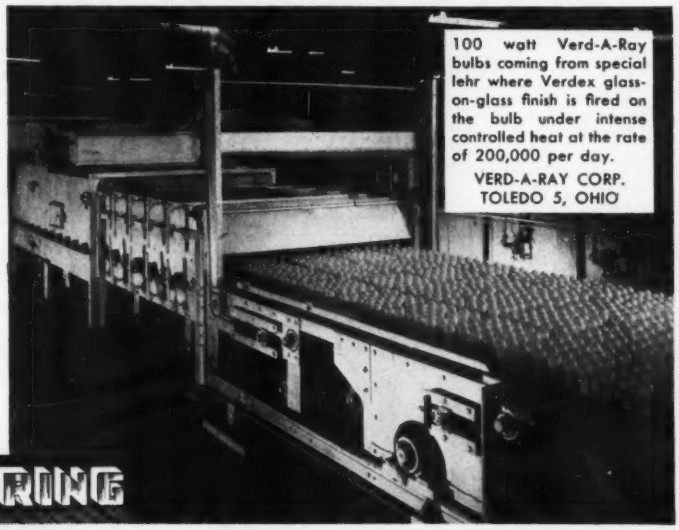

100 watt Verd-A-Ray bulbs coming from special lehr where Verdex glass-on-glass finish is fired on the bulb under intense controlled heat at the rate of 200,000 per day.
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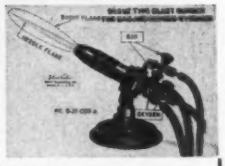

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OWENS-ILLINOIS NAMES A. G. SMITH PRESS RELATIONS MANAGER

Two appointments to the press relations staff of Owens-Illinois Glass Co. have been announced by Edward C. Ames, public relations director.

Al G. Smith has been named press relations manager and Kenneth A. Hamel will be senior product publicity specialist for the company's Glass Container Division. Both appointments are effective December 1, 1956, Mr. Ames said.

Mr. Smith has resigned as a vice president of Carl Byoir & Associates, Inc., one of the nation's leading public relations firms, while Mr. Hamel returns to O-I after six months as public relations director for the Toledo-Lucas County Port Authority.

With the Byoir organization for 16 years, Mr. Smith had been a vice president since 1948. Before entering public relations in 1937, he was a newspaperman for more than 10 years. He started as a reporter on the Waycross, Ga., *Journal-Herald* while still in high school, later covered sports and general news for the *Atlanta Constitution*, and was a reporter and editor in the Associated Press' Southern headquarters at Atlanta for four years.

Also a former newspaperman, Mr. Hamel was with Owens-Illinois for 12 years until last May 31 when he joined the Toledo Port Authority to develop its public relations program. While with O-I he was well-known in the glass container industry because of the important role he played in the organization of such national "weeks" as those for pickles, mayonnaise and salad dressing, etc.

TWO APPOINTMENTS AT CORNING GLASS

Two appointments at the Bradford, Pa., plant of Corning Glass Works were announced by W. Alfred Ende, plant manager.

Ralph W. Ytterberg has been named plant supervisor of accounting and production planning and David W. Brown is plant industrial engineer.

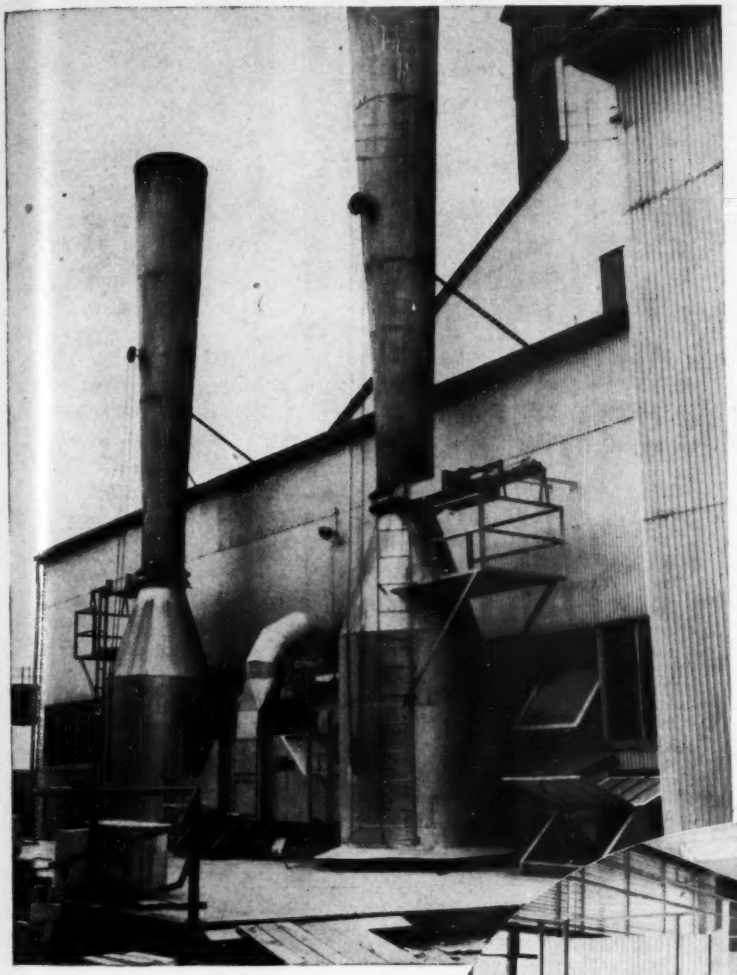
Mr. Ytterberg joined the company in 1950 as a shift foreman at the Albion, Mich. plant and then served successively as supervisor of accounting clerks at Albion, plant accountant at Pilot Plant 2 in Corning and plant accountant at Bradford.

Mr. Brown joined the industrial engineering staff at Corning last year and served there until his new appointment.

• The appointment of James H. Giles, Jr., to the Research and Development staff of The O. Hommel Company was recently announced.

• Grant S. Diamond, president of Golding-Keene Company, announces that Mr. H. B. DuBois has recently been elected to the position of vice president in Charge of Sales by the board of directors.

PRODUCTION UP - FUEL COST DOWN WITH MORGAN-ISLEY COMBUSTION CONTROLS



Morgan-Isley Ejector installation at Mississippi Glass Co., St. Louis, Mo., world's largest manufacturer of rolled glass. Inset shows one of Mississippi Glass products in use as office partitions.

In commenting on the Morgan-Isley installation at his company's St. Louis plant, Mr. Ellis Humphreys, Vice President of Mississippi Glass Co. said, "An ejector stack is far less temperamental than a natural draft stack, and, of course, is much less costly to build.

"One of the great advantages of the Morgan-Isley system comes from the secondary checkers. These give the incoming air a fine prewarming before it goes into the regular checkers. This not only results in better furnace operation, but seems to keep the regular checkers in much better condition. Incidentally, the secondary checkers seem to last indefinitely, and don't need to be cleaned during repairs. This system is good and greatly improves furnace operation."

CCC48

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CHANGES OF DEPARTMENTS AT AMERICAN POTASH & CHEMICAL

W. M. Clines

A. J. Dirksen

A realignment of the Eastern Sales Department of American Potash & Chemical Corporation into two operating groups has been announced by William J. F. Francis, vice president in charge of sales.

E. M. Kolb

Under the new management the department will operate as the Heavy Chemicals Division and the Industrial Chemicals Division. Ed M. Kolb has been named as general sales manager of the Heavy Chemicals Division, while Dr. Al J. Dirksen, formerly director of the Market Development Department, has been appointed general sales manager of the Industrial Chemicals Division. Their headquarters will remain at the company's Eastern general sales office in New York City.

William M. Clines, formerly western sales manager, was named general sales manager, western, to handle all company sales in the western area. Cline's headquarters will continue at the company's executive offices at Los Angeles.

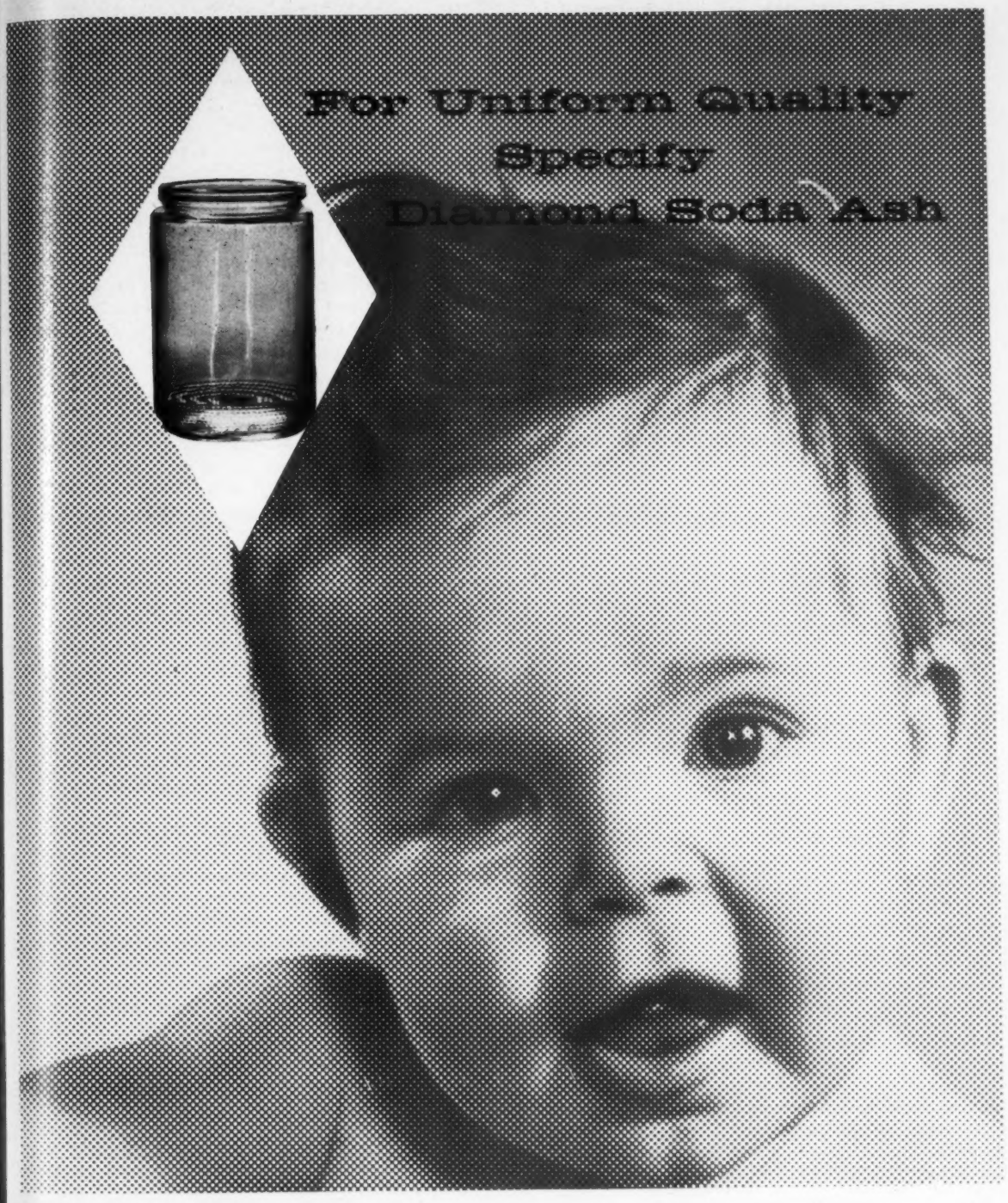
The Heavy Chemicals Division will be responsible for AP&CC's steadily-expanding eastern sales activities in borax, potash and sodium sulfate (salt cake), as well as the administration of the company's Export Department and the British subsidiary, Borax & Chemicals, Ltd.

The new Industrial Chemicals Division will handle company eastern sales for lithium, boron, Tronacarb, electrochemicals such as chlorates, perchlorates and manganese dioxide, as well as all new product marketing.

CARBORUNDUM APPOINTS R. W. BROWN

Appointment of Roy W. Brown as manager—Technical Services has just been announced by B. M. Johnson, vice president and general manager, Refractories Division of The Carborundum Company, Perth Amboy, N. J.

Mr. Brown joined the Division in 1947, conducting special research work and also engaging in engineering and development of new products. Since November, 1950 he has been in the Gulf Coast area as Refractories Engineer.



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DIAMOND ALKALI CHEMICALS

Diamond Chemicals